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IN THE EVENING OF MY THOUGHT

IN TWO VOLUMES

VOLUME II

IN THE EVENING OF MY THOUGHT

BY
GEORGES CLEMENCEAU

TRANSLATED BY
CHARLES MINER THOMPSON
AND
JOHN HEARD, JR.

VOLUME II



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CHAPTER X THE ATOM

THE THRESHOLD OF THE ATOM

THE primitive fictions of the ancient cosmogonies cannot be compared with the scientific information of to-day unless we pause over the chief cosmological phenomenon, the problem, that is, of the basic substance of the universe, analytically dissociated by the ancient philosophers until the final discovery of the atom. For that atom, which was a figment of the imagination, suddenly presented itself as scientific fact. We have grasped it, observed it,¹ measured it, analyzed it, and dissected it in such a way as to extract from that actually existing thing every explanation — whether or not possible to verify — of which it will admit. For the future, our ideas of the structure of the Cosmos will have a scientific basis to which physics and chemistry have already contributed. We have caught the atom in the act, we have captured it alive, and we find ourselves in the same dilemma as did the man who caught the bear by the tail, for it is harder to imagine what is beyond the atom and its electrons than it is to take a trip to Sirius.

Is there something beyond the atom? Why not? Why should there not be something even beyond that something? A contrary supposition would be more disconcerting, especially at a time when people are discussing the disintegration of matter. In the range of related values the very little is at the opposite pole of the very big, so as to achieve

¹ 'It seems that we have seen the atoms, since we count them,' observes Henri Poincaré, though as yet we have seen only their wake.

infinity in every direction. Under our eyes the atom breaks up. The electrons revolve around their nucleus as the planets revolve around their suns. What would happen to us if the atom, which continuously disintegrates, should give us the slip and leave us wholly adrift? Meanwhile, we cannot refuse to recognize this newcomer which, less secretive than the always hypothetical ether, asks only for recognition. The indefinite revision of our provisional truths demands that they be subjected to successive rehandlings, the justification of which lies in the relativity of our knowledge, increased by the variable aspects of a cosmology¹ eternally in formation.

The innovations of modern physics have brought about a complete revolution, not only in physics itself, but in the remotest regions of the whole system of knowledge. The discovery of the X-ray by Roentgen, and of the radioactivity of uranium by Becquerel, date only from 1896. In the eyes of the public, wireless telegraphy and telephony marked the entrance of the human mind into an era of wonders. Then there soon appeared successive phenomena which carried us at a bound to the very heart of the problem of the structure of the universe and of its movements. Simultaneously, science and philosophy, with all their ancient postulates in confusion, rushed to the outposts of knowledge, and a generation of eager investigators suddenly and impatiently threw themselves on the new vein in the quarry in order to exploit it to the full measure of their ability, even though they might go too far.

I have said that I should keep within the limits of what the man of ordinary culture of to-day knows, and I distinctly appreciate how easily I may go beyond it. But how can I avoid the risk, when all earlier science is suddenly shaken from top to bottom by the discovery of movements among the elements which require fresh explanations of newly discovered phenomena? The majority of people

¹ The word 'cosmogony' is scientifically meaningless, since it does not correspond to any actual point of time. It survives such as we received it from primitive ignorance. 'Cosmology' is the scientific word.

necessarily live far from laboratories, and metaphysics has done its best to disgust them with philosophy. However, all the attempts at intellectual adaptation, attempts in which empirical misconceptions make us stumble at every step, end in reaching the common run of humanity, with its impulsive enthusiasms struggling in the inextricable jungle of tradition. Passive mediocrity, eager to renew the forms in which it clothes its ignorance and resisting as long as possible any change that is not merely verbal, awaits amid the byways of jumbled knowledge and error the signs of a new dispensation to come from behind those famous laboratory walls which conceal unknown happenings.

Nevertheless, men of science would waste themselves in academic discussion were it not for the crowd of popularizers who follow them.¹ That explains why the British Association for the Advancement of Science, whose great merit is universally recognized, does not disdain to address itself once a year to the general public in order to make a scientific communication directly to it and to keep it alert to the rallying cries of the sentinels at the front. I have just been reading a most effective lecture that Sir Ernest Rutherford delivered at a public sitting of that eminent association at Liverpool on 'The Electrical Structure of Matter.' Since the public is interested, I no longer hesitate. I shall not attempt a scientific exposition of the subject, but shall merely outline some of the principal points.

THE ATOM TO-DAY

The atomic theory, based on a hypothetical ultimate state of matter endowed with unknown properties, goes back, as we know, to the first period of broad generalization. Before meeting the atom in Leucippus, in Democritus, and in Epicurus, we discover it in Manu — a distinguished company. Imaginative men philosophized about the atom

¹ Popularization, which is of every degree of excellence, is not always justly rated. Science has human value only through being diffused. On the other hand, if men of science did not sometimes feel a good-natured contempt for the vulgar crowd, they might too often allow themselves to be halted by the opposition of the ignorant public — multifarious in its forms.

when it was still unknown to science. Accidentally the hypothesis finally entered the domain of established phenomena. See the result. Physico-chemistry has already seized upon the atom and defined its mass, its weight, and its structure. From that time on, the atom ceased to be the recalcitrant X, hidden below the residuum in the hermetically sealed melting-pot of the universe. It is, if not the ultimate element of the Cosmos, at least one of its elements.

Some day perhaps, a fate identical with that of the atom will befall the hypothesis — no less ancient, but for lack of scientific observation even to-day imaginative — of a medium in which the atom is appointed to move. The 'ether' was, and for the present remains, something which we have not yet identified, but without which, so far, no conception of the action of energy can hold. The electromagnetic theory, for example, cannot dispense with the medium of the so-called ether. From the beginning of time, the particle of the atom named the electron awaited in the outer darkness the hour which has now struck. To-day we can venture to speak of 'showers of electric projectiles that reveal atomic energy.'

In that form the hypothesis of the identity of substance, as Democritus outlined it, seems to be confirmed, in spite of the fact that we recognize that the atom with its electrons, its nucleus, and its protons is made up of parts. We must still wait. The transmutations — or disintegrations — of uranium into radium, as well as of uranium and of radium into helium, not to speak of the evolution of the atom discovered by Sir Ernest Rutherford, open a field of experiment which will doubtless require a long period before any accurate scientific synthesis can be made.

Our observations do not indicate that the atom of any so-called element — lead, copper, iron, or sulphur — always preserves its individuality. Too much still remains unknown about the phenomena of 'disintegration' in radioactive substances. The investigation of atomic weights supplied chemistry with the elements of a valuable discovery,

which experiment has confirmed, and by means of which series of new relations among the elements were finally classified. The comparison of atomic weights then suggested that the atoms of different elements might be only aggregates of atoms of hydrogen which represented the unit of weight. I cannot describe in detail the series of experimental tests in which scientists engaged in order to verify that hypothesis.¹

All that I can say is that the transformations of radio-active substances seem to produce substances chemically different in the character of their radio-active radiation. Thus lead derived from minerals in which uranium occurs has a lower atomic weight than ordinary lead, the supposed end-product of the radio-active series. These are called 'isotopic' bodies, because they occupy the same place in chemical classification. The word at least describes a new state of relations. It appears that we have eight kinds of tin, three kinds of magnesium, six kinds of mercury, etc., etc. The frail hypothesis of 'elements' is badly shaken. Our old torch flickers out. A new star is about to rise.² Let

¹ The reader will find them described in an article by Charles Nordmann (*Revue des Deux Mondes*, for April 15, 1924), the scientific audacity of which takes the form of the most sweeping generalizations.

² Our chemistry, like our physics, is being renewed. The chemist, seeking to isolate a limited number of elementary substances, succeeded in describing and identifying almost ninety primary substances, or elements, strongly individual in their physical and chemical properties, but irreducible to a single constituent. It is certain that, now that the discovery of radio-activity has confronted us with new activities, the theory of the structure of elements must be recast. The present classification of elements is based on the theory of isotopy, on which at the moment scientific effort is concentrated.

Since the final product of the spontaneous disintegration of the radio-active families is lead, we must admit that the element lead may be a mixture of two, or of several, atomic species, identical in respect to their chemical properties, but distinct in respect to their atomic mass. These twin species occupy the same pigeonhole of classification; they are 'isotopes'; that is, they are grouped at the same point in the table.

Each atom is, as I have already said, constructed like a planetary system. Almost the whole mass is at the center in a nucleus of prodigious density, and positively charged with electricity. The remaining mass, which is inconsiderable, is divided into very minute masses, which are negatively charged with electricity, and which revolve around the central nucleus in one or more orbits. Those minute bodies are the electrons. The total number of planetary electrons

us open our eyes. Let us open them all the more attentively since we meet the unexpected when we are forced to recognize in the arrangement of the electrons a true planetary system.

The discovery of radio-activity, with its three different rays, does not permit us to rely on antiquated conceptions. To-day we know of no less than thirty forms derived from uranium alone. What of those atomic explosions, the proportions of which baffle conception? Ray No. 1 — Alpha — enables us to penetrate the interior of the atom, and to examine the nucleus. It is the flash of a transmutation into an atom of helium, with an enormous charge of energy. It shows us, through a gas, not only the Alpha ray, but every kind of radiation which produces ions, or any other electrified particles. We can determine the number and the mass of atoms and the atomic nature of electricity. We can determine the unit of charge, as well as the number of molecules, and many other highly interesting facts.

'The atoms are quite unsymmetrical structures in respect to the positive and negative units contained in them.'¹ The mass of the atom is the sum of the electric masses of the unit charges that compose it. Observation of atomic encounters shows that if the laws of mechanics are to apply, the atom must be composed of a small massive nucleus that carries a charge of positive electricity, and that is surrounded by the number of negative electrons necessary to form a neutral atom.

In a heavy atom like that of gold the radius of the nucleus, which is assumed to be spherical, is less than a thousandth part of the complete atom enclosed in its electrons,

is equal to the atomic number of the element. The 'isotopes' of any given element have the same number of planetary electrons and consequently the same chemical properties, since these depend on the superficial electrons. The only difference among different isotopes of the same element lies in the internal configuration of the central nucleus.

The theory is — and experiment in part confirms it — that we can refer all the elements back to hydrogen and helium, the condensation of which produces them.

¹ Sir Ernest Rutherford.

and since the outer electrons are necessarily equilibrated by the attraction of the nucleus, their arrangement and their movement have to be governed by its extent.¹ Since the physical and chemical properties of the atom are dependent on the mass and on the motion of the outer electrons, its properties are represented, not by its atomic weight, but by the charge of the nucleus. By means of a series of deductions, investigators succeeded in getting an approximate idea of the orbit of the planetary electron as it revolves around the nucleus.

By way of illustration, Rutherford draws the following picture of the heaviest atom, the atom of uranium:

'At the center of the atom is a minute nucleus surrounded by a swirling group of ninety-two electrons, all in motion in definite orbits, and occupying but by no means filling a volume very large compared with that of the nucleus. Some of the electrons describe nearly circular orbits round the nucleus; others, orbits of a more elliptical shape whose axes rotate rapidly round the nucleus. The motion of the electrons in the different groups is not necessarily confined to a definite region of the atom, but the electrons of one group may penetrate deeply into the region mainly occupied by another group, thus giving a type of interconnection or coupling between the various groups.

'The maximum speed of any electron depends on the closeness of the approach to the nucleus, but the outermost electron will have a minimum speed of more than one thousand kilometers per second, while the innermost K electrons have an average speed of more than one hundred and fifty thousand kilometers per second, or half the speed of light. When we visualize the extraordinary complexity of the

¹ 'It can be asserted that the diameters of various atoms are certainly less than a hundred thousandth — perhaps less than a millionth — of a millimetre, and that the mass even in the case of the heaviest atoms, such, for example, as the atom of gold, is certainly less than a hundred thousandth — perhaps than a hundred millionth — of the trillionth part of a gram.' (Jean Perrin, *Les Atomes*.)

Farther on, Perrin explains how scientists have been able to discover and to weigh the atom of an elementary substance in nebulae so distant that it takes centuries for their light to reach us.

electronic system, we may be surprised that it has been possible to find any order in the apparent medley of motions.' ¹

Throwing caution aside, the same observer writes:

'The atomic processes involved may be so fundamental that a complete understanding may be denied us. It is early yet to be pessimistic on this question, for we may hope that our difficulties may any day be resolved by further discoveries. . . . The nucleus of a heavy atom is undoubtedly a very complicated system, and in a sense a world of its own, little, if at all, influenced by the ordinary physical and chemical agencies at our command. When we consider the mass of a nucleus compared with its volume, it seems certain that its density is many billions of times that of our heaviest element. Yet if we could form a magnified picture of the nucleus, we should expect that it would show a discontinuous structure, occupied but not filled by the minute building units, the protons and electrons, in ceaseless rapid motion controlled by their mutual forces.'

This distinguished scientist had previously said:

'The electron is the body having the smallest mass so far known to science. It carries in itself a negative charge mathematically evaluated in electrostatic units. Its presence was recognized only through its rapid movement at velocities that have been mathematically determined, with an apparent mass in electro-magnetic units. That apparent mass increases when the speed approximates that of light.' . . . The negative ion is made up of an electron to which is attached a group of molecules. The positive ion is made up

¹ As Pascal had so sagaciously predicted, we see that the marvel of our starry vault, everywhere sown with solar systems and with nebulae in every stage of evolution, may well be surpassed by the spectacle of the atom with its perpetually gyrating fires. The great prodigy, the secret of which we should like to learn, lies in the correspondence between the systems at the opposite extremes of the field of our sensation. It is an astonishing result of simplification that some day, perhaps, our descendants will regard as the most natural of elemental manifestations.

² Einstein's principle of relativity maintains that light has both mass and weight. (Jean Perrin.) And Henri Poincaré adds that mass is equally dependent on direction.

of a molecule from which an electron and the other molecules attached to it have been expelled.

'Every projected radio-active particle, on account of its great kinetic energy, liberates a large number of ions as it collides with the molecules of gas which lie in its path. The method of ionization varies with the velocity, but it is certain that each projectile produces in its course many thousands of ions before its movement loses its energy.'

I partly open the door of the mysterious cavern, but I do not dare venture farther. I simply put my trust in this final opinion of that same scientist: 'The major part of radio-active radiation consists of a current of electrically charged particles discharged at high velocity. It seems most improbable that the particles can suddenly acquire their enormous speed through being projected either by an internal or by an external activity of the atom. . . . Therefore, it seems probable that the particles are not suddenly set in motion, but escape from an atomic system, in which they are already engaged, either in rapid oscillations, or in following an orbital curve.'

'Emanation,' transformation, recognized disintegration, and the reintegration which we suspect to exist, must inevitably lead us to infer repetitions about which we can frame hypotheses to our hearts' content. But I must set myself some limit. Studied by Rutherford, the progressive processes of radio-activity in the successive substances in which they manifest themselves, show transformations of energy that point to a unitary synthesis, of which we catch a dim glimpse. The important point, however, is to recognize that the material character of certain rays is established, and that the radio-active disturbances among elements heretofore regarded as distinct indicate successive phenomena, in which simple bodies seem to contain a varied number of doubles or counterparts, while atomic disintegration leads to new products of a provisional simplicity, which suggest a further dissociation, about which it is too early to speak. At different degrees, according to the stage of evolution, all bodies are, or probably have been at some particu-

lar time, radio-active, and since radio-activity is accompanied by heat, the problems in the field of universal vibration assume forms before which boldness gives way to timidity, and we grow cautious.

Rutherford, J. J. Thomson, and many others have sought an explanation of radio-activity, but have been unable to satisfy themselves. Thomson — a scientist of the first rank — is obliged to state: 'We are forced to conclude that no particle suddenly acquired this motive energy, but that from the start each particle was in rapid motion within the atom, and that it was suddenly liberated at the velocity it had previously possessed.' Rutherford reached the same conclusion. We are faced with a huge interrogation mark as to the majestic oscillations between the known and the unknown amid the tumults of the inexpressible infinite. To help us keep our patience, we are told that 'when the series of transformations is complete, there will probably remain a product, or products, that will be inactive or active for a brief period only.' The remark is an attempt to explain the appearance of the mysterious helium as the provisional ultimate of radio-active transformation. It is a phrase offered as a temporary resting place for our inadequate minds.

Rutherford's chapters on the origin of radium, which of course can be no more than a representation of previous transformations, act as new vistas cut through the underbrush of our intelligence. He tells us that a mass of radium left undisturbed for some thousands of years will lose an important part of its radio-activity. Does the expenditure of matter and of energy perfectly correspond, or, to confuse us even more, shall we discover that it is unequal? Let us not dodge any problem. We know little or nothing of some of the relations that exist among uranium, radium, thorium, actinium, radon, helium, and their successive derivatives. I like to believe that, if man is granted a long enough life, we shall some day be able to throw a definite light on them.

We have been told that 'the maintenance of the heat of the sun for a long period presents no fundamental difficulty

if we admit that a process of disintegration, such as we find in radio-active elements, goes on in the sun.' 'It is probable on the whole,' Lord Kelvin calculates, 'that the sun has not lighted the earth for a hundred million years only. It is almost certain that it has been lighting it for five hundred million years.'

If, according to Jean Perrin's hypothesis, the pre-solar nebula was composed of hydrogen, there was produced, 'merely by its condensation into helium, heat enough to support the radiation of the sun for a billion years. . . .' 'The fact easily accounts for some millions of years of that scarcely varying radiation of which biology supplies the proof.' 'If,' Perrin further observes, 'radio-active elements are as abundant at the center of the earth as they are at its surface, the earth would be more than a hundred times more radio-active than it need be to explain the preservation of its central heat.' There is no contradiction in that; but, were solar radiation to fail, we should none the less die of cold on our brazier of burning coals. Mathematical calculations, or even imagination, can postpone the end of the evolutionary term; but that end cannot be avoided.

I can do no more than mention the theories that deal with the evolution of matter and with the possibility of a fourth state, which might, perhaps, be the ether. Rutherford, who in respect to that question restricts himself to following Sir Norman Lockyer in his 'Inorganic Evolution,' does not hesitate expressly to point out the possibility of a future evolution of the atom in the far reaches of time.

We know that the atomic unit explodes into a dust of sub-atoms animated with electrical energy. Scientists are now discussing other particles that constantly travel in an orbit. Indefinite reduction in size is harder for us to grasp than limitless increase. But why should cosmic fact trouble itself about the evolutionary relativity of its human product?

The 'emanation' of radium, become a new body under the name of radon, is, like radium itself, progressively destroyed. Thereupon scientists tell us that all 'radio-

activity is the sign of the transmutation of an atom into one or several other atoms' (Perrin). And again: 'These transmutations are discontinuous. . . . They are bound atom by atom to explode unexpectedly, and it is precisely during the explosion that the rays pour out.' Planck's *quantum* theory, that is, the theory of discontinuous activity, leads to the idea of grains of energy that in indeterminate forms are analogous to grains of electricity, namely, electrons, ions, protons, the constituents of atoms, of molecules, and of all complex aggregates which require discontinuity of energy if they are to correspond to a discontinuity of substance, the activities of which are coördinated by the resonance of the *quanta*.

If the reader who wishes intimately to follow the new ideas cares to make the effort, he will obtain much satisfaction from Perrin's able studies of the atom. I have mentioned that the curtain of the unknown was being rent. Better still, a dazzling system of movements appears among the elements to awaken our wonder with a fairyland of fact — something that was beyond the power of presumptuous theology itself. Every one knows by what magic ruses the divine Proteus vainly tried to escape. The persevering Greek hero succeeded in conquering him. To man, anxious to know, the god must yield his secret.

That secret must be sought in the inextricable complexity of those collisions of vibratory waves in which we see the phenomena of resonance, like that of the tuning fork, multiply themselves. 'The average energy of the oscillations,' Planck tells us, 'becomes extremely small when the frequency becomes very great. . . .' Presumably, that oscillatory energy is the same as it would be if it were exclusively maintained by the collisions of the molecules . . . and mathematics show that the energy of each oscillator varies in a discontinuous fashion. Planck assumed that it varied by equal *quanta* in such a way that each oscillator always contains its entire number of atoms of energy, or, if you prefer, 'grains of energy.'¹ Einstein, going farther, claims that 'in

¹ Jean Perrin.

a solid body each atom is urged towards the position of equilibrium by elastic forces in such a way that, if it is thrown a little to one side, its vibrations have a definite period' — whence arises the profound phenomenon of 'universal resonance' which constitutes the coördination of the Cosmos. According to Einstein, 'even the elastic properties of solid bodies afford a means of predicting the frequency of the vibrations of an atom thrown out of equilibrium.'

In passing, I again call especial attention to Perrin's chapters on the discontinuity of rotary velocities and on the distribution of substance in the atom and in the molecule, which ends in this unsatisfactory formula: 'The smallest velocity of stable rotation is equal to more than a thousand million revolutions in a hundred-thousandth of a second.'¹ After that, nothing remains at present for us to do but close our eyes and try to gather ourselves together. I can only turn the pages in an attempt so to excite the curiosity of the reader that he will turn to them. Perrin has written admirable chapters on radio-activity, on molecular structure, and on the so-called Brownian movement of molecules. Would that I could follow him indefinitely!

Moreover, we thus come to the threshold of the inevitable generalizations, which are so keenly tempting to our culture, and which are an inextricable tangle of ignorance and knowledge. Let us try to check audacity by prudence. 'It follows from the remarkable labors of Sir Joseph Thomson,' writes Perrin, 'that the atom of electricity, the existence of which has been successfully established, is an essential constituent of matter. . . . Every ionization divides the atom, on the one hand, into one or into several negative corpuscles of insignificant mass, and on the other hand, into a positive ion of relatively greater weight, formed from what remains of the atom. Strictly speaking, the atom is not indivisible, and it perhaps consists of a sort of positive sun in which its chemical particularity resides, and around which moves a cloud of negative planets alike in every atom. . . . Each

¹ Let us not forget that the movement of the atomic projectiles is, like that of our planets, both forward and rotary.

radio-active element has a corresponding period, or duration, during which half its tangible mass undergoes transmutation. For radium that period is approximately two thousand years.' There follows a table of various transmutation periods which range from one five-hundredth of a second to the five billion years required to transmute uranium into helium.

'Invariably,' the same writer remarks, 'light atoms are obtained through the disintegration of heavy atoms. . . . If the heavy atoms come into being again, the event must take place at the center of stars, where the temperature and the pressure, which become enormous, bring about the reciprocal penetration of the atomic nuclei, as well as "the absorption of energy," or, rather, of the charges of energy. We are obliged to admit that a projectile of helium pierces the atoms, since the interstices cannot conform to the line of emission. . . . A bullet traveling at a sufficiently high velocity would pass through a man without harming him. . . . The Alpha ray, before coming to rest, pierces approximately a hundred thousand atoms of aluminium . . . the original energy of such a projectile being more than a hundred million times greater than that of a molecule in the usual thermic agitation.' ¹

Shall I add that the phosphorescent scintillation of the projectiles on surfaces that intercept them marks the points they hit and permits us to count them, and that, thanks to this phenomenon, we have been able to detect their trajectories even with the naked eye? The marvelous way in which the ascertained facts point in the same direction allowed Perrin to check the observed measurements one by the other, and he concludes: 'The atomic theory has triumphed. But as the result of that very triumph we see whatever was definitive and absolute in the original theory disappear. . . . Atoms are not eternal and indivisible elements, the irreducible simplicity of which gave a limit to the possible, and we begin to suspect that in their unimaginable minuteness there is a prodigious swarming of

¹ Jean Perrin.

new worlds. In the same way, beyond the familiar skies, beyond those gulfs of gloom that light takes thousands of years to traverse, the dazzled astronomer discovers pale wisps of light, lost in space. There are immeasurably remote 'milky ways,' the feeble light of which reveals the throbbing fires of millions of gigantic stars. Nature discloses the same limitless splendor in the atom and in the nebula, and every new means of knowledge shows her more vast, more diversified, more prolific, more unexpected, more beautiful and richer in her unfathomable immensity.'

What can I add? The temptations to seek access to the inaccessible are infinite in number. How disconcerting to our rigorous exactions is the idea that the remote but inevitable cooling of the sun is bound to arrest a human evolution which, within the universal and eternal cycle the radius of which is not to be determined, might swing full circle to its starting point.

In conclusion, Sir Ernest Rutherford, in words the circumspection of which should be noticed, resolutely attacks the well-known problem of the evolution of energy. Having established the fact that in the course of the disintegration of a gram of radium the total evolution of energy is many millions of times greater than it is in the complete combustion of an equal weight of carbon, he warns us against the idea of any universal concentration of energy, of which radio-activity would be the outlet. On that theory, as every one knows, is based the dream of unmeasured forces which, some day, we might control.

On this point the eminent scientist sets up an hypothesis worthy of mention, because of the new ideas it suggests: 'It is possible,' he says, 'that the elements uranium and thorium are now the last survivors of a type of element common in the remote ages when the atoms that actually compose the planet were in process of formation. Because of the slowness of their transformation, a certain proportion of the atoms of uranium and of thorium formed at that time may have survived through that long period. We might consider that those atoms had not as yet achieved the

cycle of change long ago completed by ordinary atoms. They might be considered to have been kept in a state of excitement, which prevented the nuclear units from settling into a state of final equilibrium, and which has left them with a surplus energy that can be liberated only in the characteristic form of radio-activity. According to the terms of this hypothesis, the presence of a sum of energy ready to be set free is not necessarily a property of all atoms. It is simply a question of a special class of atoms, called radio-active, which have not yet reached a final equilibrium.'

That the atom of to-day may be different from the atom of the past is a novel view. That the atom with its electronic system evolves can surprise no one; that it should evolve is essential to the general order of things. The 'final equilibrium' of which Rutherford speaks is simply a question of one form of electricity neutralized by another — a phenomenon which, like all other phenomena, is transient. Fruitful or barren, hypotheses of every kind at least afford us the pleasure of knocking at the door of possibility. Science based on observation, if it is to grow, must, like the young bird seeking to leave its nest, take its first flutter.

That fact the lecturer recognizes not without emotion, when he congratulates himself on having been born in an age which permits him to be present at the birth of new ideas. He expresses a frank wonder at the return of science to conceptions of 'comparative simplicity,' only to give the credit therefor to 'the scientific method that underlies our knowledge of the natural world. Experiment, controlled by disciplined imagination, is capable of attaining results unequalled by the uncontrolled imagination of the greatest natural philosopher. Experiment without imagination, and imagination not directed by experiment, cannot achieve progress. The happy union of those two powers is essential. To us the unknown looks like a thick fog. If we are to advance in that obscurity, we must not count on the aid of supermen. Everything depends on the combined efforts of ordinary men, animated with enthusiasm and endowed

with scientific imagination. Each clears a path in his own field, and the work of one affects the work of all. Then, from time to time, there springs from the accumulation of knowledge a blaze of ideas which lights a wide expanse, and which reveals the reciprocal influence of all the toilers.'¹

I could not resist the pleasure of quoting such noble words in support of what I believe that I understand of the progress of human knowledge. Inspired by a general vision of the world, from which it is impossible to banish imagination, I try, under the guidance of our masters, to gather disconnected heaps of scientific observations. What greater satisfaction than to hear authoritative voices announce the great afflux of thought by which generalizing minds are inspired!

In every civilized country generations of able workers march toward the conquest of the problems of the universe. They are aided by a slowly forming state of intelligence, capable, perhaps, of preserving man from too burdensome misconceptions aggravated by the universal conflict of interests. On the field of the future, I see a youthful band assembling — the flower of French thinkers — who, I am sure, will not be unworthy of their great predecessors.

THE ATOM IN THE STREAM

When the nature of the atom has been determined — if the word is not too ambitious — we shall still be faced with the task of relating its phenomena one to the other, in order to fit atomic activity to the activities that precede and follow it. The scientific conception of the atom was bound to inaugurate a general revision of our scientific structure.

The relation between the atom and the molecule has a complexity, the most elementary facts of which we are beginning to learn. Hypotheses are never lacking, and the fewer the observed facts, the more tempted we are to multiply conjectures. Chemists long ago sketched atomic

¹ Such is the deep philosophy of popularization which brings about the assimilation of knowledge through a gift of communication not always given to mere scientists.

structures, and their sketches were very helpful. But, from a sketch to a working drawing of the phenomenon that supplies the conditions necessary to group and build the atoms into a molecule, is a distance which it will take long to travel.

If, amid the clouds of their metaphysics, theologians could have brought themselves to submit their hypotheses to the test of scientific knowledge, they would have been real pioneers. As long as the atom was a mere figment of the mind with no objective characteristic, it remained, even though only an hypothesis, the forerunner of those hypotheses of the future which were waiting to exchange the intangible prestige of mystery for the human achievement of a fathoming of the unknown.

That day has come. The atom has withstood the glare of the spot-light; all indications are that it will continue to hold the stage. It was especially the magic gift of invisibility which made it and the ether quasi-divinities. Whenever we are forced to regard as facts the qualities which we have attributed to the ether in order to endow it with reality, it will meet the same fate as did the atom. The hypothesis will lose its hypothetical glory and descend to the less dazzling, but more solid, status of a fact which was suspected before it was scientifically established.

From the days of Manu to those of Lucretius the atom received every honor, except prayer, which man offers to the divine 'Something.' Its intangible aloofness was due to the same reasons which prevailed in respect to Jahveh; man made no images of it. This endowed the atom with a mystical power superior to that of the many representations of those secondary divinities which encumber our so-called monotheistic temples. The atom has appeared before us for judgment, — as has been the ultimate fate of all the gods that were, — and in our preliminary analyses we have found it utterly different from what it was proclaimed to be. We now count our atoms, we analyze them into active sub-atoms, and our first studies of this new kinematics oblige us to recast our latest theorems of the nature of energy.

Kant arraigned the earlier conception of the atom in his famous antinomy: 'If matter is made up of elements, the elements must be without extension, since otherwise they would be divisible. If they are without extension, we cannot admit that elements which have no extension can collectively produce a composite which has extension. If, on the other hand, that composite is not made up of simple elements, it is indefinitely divisible. But there must necessarily be a limit, for otherwise the infinitely small would be zero, and we cannot conceive a composite made up of nothing.' That is a fine thrust, yet one not especially hard to parry. Infinite division cannot produce zero, since it always assumes an infinitely remaining quantity to be divided. Of what consequence is it, then, that at any stage we may discover a mass that, because of the imperfection of our instruments, we can or cannot continue to divide? How can the existence of the atom, in terms of the Cosmos, depend on human inadequacy? 'Man,' we are told, 'measures all things by himself.' Indeed, to us, greatness or smallness acquires a meaning only by comparison with ourselves. It is time to concede to the universe something beyond human dimensions, even if, by so doing, we feel ourselves less important.

In a very fine lecture delivered in 1912 before the Société Française de Physique, Henri Poincaré attacked the new problems of the atom with the smiling sincerity of an attentive observer whose bold flight, not innocent of ironic reservations, sought to coördinate the facts in an all-embracing whole and even outstripped the facts, as a mathematical mind always seeking the absolute is prone to do.

He claims that 'gases consist of molecules circulating in every direction at great velocities. Their trajectories would be rectilinear if from time to time they did not collide, or if they did not strike the walls of the container. . . .'¹ Now, those laws are not true merely of gases. The same general dynamic laws apply to liquids and to solids. Thus the ordinary aspect of things is suddenly changed. A solid

¹ *Dernières Pensées: L'hypothèse des quanta.*

becomes merely a swarm. Through flowery ways the approximately verified theory of *quanta*¹ leads us to a point where we are confronted with moving atoms of electricity and of magnetism, with atoms of energy, and, it has even been said, with atoms of space and with atoms of time. Such a formula would revolutionize our present conceptions of the universe by basing the system on a theory of discontinuity. However, 'he who first witnessed a collision,' writes Poincaré, 'thought he was observing a discontinuous phenomenon; now we know that what he saw was no more than very swift, but continuous, changes of velocity.' He does not venture beyond that affirmation, which smacks of hypothesis. The reader will pardon me for having led him in such brilliant company, and with the necessary precautions against possible vertigo of incoördination, to witness such attempts to plumb the abyss.

'The kinetic theory of gases,'² the same writer says, 'has received unexpected support. New theories have been drawn after exactly the same pattern; on the one hand, there is the theory of solutions, and on the other hand, there is the electronic theory of metals. The action of the molecules of substances in solution, and also of the free electrons to which the metals owe their electrical conductivity, is similar to that of the molecules of gas within the space in which they are enclosed. The parallel is perfect; we can follow it even in numerical coincidences. And, by reason of that similarity, what was doubtful has become probable. Each of the three theories, if it stood unsupported, would seem merely an ingenious hypothesis for which we could

¹ The word atom is employed here as it used to be employed; that is, in the sense of an ultimate, and not, as it is used to-day, to express our sense of a substratum of energy. Poincaré, seeking simplified generalizations, does not hesitate to adopt the formula according to which moving atoms are nothing but a kind of electric tracks in the propagating medium of the waves to which we give the name of ether. Without hesitation he repeats Lorentz' dictum: 'THEY ARE HOLES IN THE ETHER.' No matter how I rack my brains, I cannot see how a body can be built of holes — bound together by the tracks of moving holes.

² The kinetic theory of gases is that gases are composed of molecules which shoot in every direction. The same thing is true of liquids and of solids, which perpetually vibrate.

substitute other explanations almost as plausible. But since in each of the three cases we should have to substitute a different explanation, the established coincidences could no longer be attributed to anything except chance, which is inadmissible. The three kinetic theories, on the contrary, make the coincidences necessary. Furthermore, the theory of solutions leads quite naturally to that of the Brownian movement, the thermic agitation of which cannot be regarded as a figment of the mind, since it can actually be seen under the microscope.' Poincaré avails himself of Perrin's brilliant feat in determining the number of atoms in order to conclude that it was 'the many cases of coincidence among results obtained by entirely different procedures,' which convinced him. The argument has weight.

Increasing with the rising of the temperature, molecular agitation as recognized by the kinetic theory of gases decreases with the lowering of the temperature. That decrease is the effect of pressure, and stops (theoretically) at absolute zero, if we set aside the case of an asymptote, which would lead us and absolute zero itself we know not whither. Concerning the formation and the arrangement of molecules and the energy of their rotation through the effect of collisions, I can only refer to Perrin. A group of hypotheses and of established laws is involved, which are falling, or which will fall, into adjustment, as verification may dictate.

I limit myself to noting the oscillation of the atoms within the molecule. The characteristic of the Brownian movement is that it never ceases. As to the kinetics of gases, which exert a pressure on every confining surface, and which result from the collisions of molecules, Perrin says: 'Each molecule of the air that we breathe moves with the velocity of a rifle bullet, covers in a straight line in the interval between two collisions the ten-thousandth of a millimeter, and is turned from its course five thousand million times a second. There are thirty billion billion of them in a cubic centimeter of air. It would take three million of them set in a straight line to make a millimeter.'

These novel points of view, so far from the simplicity that

the ancient doctrine of the atom sought to establish, make the modern atom unfathomable in its complexity. Each new discovery of physics reveals a new complication of the atom. It requires only a correct statement of the problem to make us understand that the facts cannot be otherwise.

Is, then, radio-activity merely the splitting up of the atom into smaller atoms, which are negative electrons gravitating like planets around a big positive nucleus that in the atomic system corresponds to our sun? The fact seems not to be disputed. The mutual attraction of positive and negative electricity makes the system cohere, and governs its periods, etc. In addition, we meet electrons wandering by themselves as the comets wander from one stellar system to another and perhaps establishing among distant systems a free exchange of 'energy.' They obey, we are told, the same kinetic laws that are obeyed by the ever-moving gaseous molecules, which, because they are always moving, make metals conductors of electricity.

After the so-called atom of electricity came the 'magneton' of Pierre Weiss, or the atom of magnetism, which was discovered by observing magnetic bodies and studying the spectrum of simple substances. We saw the lines of the spectrum gather into series, each of which obeyed laws that related them to musical harmonics. . . . Thereupon Poincaré imperturbably pursued his argument: 'How is it that the atoms of hydrogen can show many lines in the spectrum? The reason is that many atoms of hydrogen differ from one another in the number of electrons contained in them, and that each of these varieties of atoms shows a different line . . . a magneton may be said to be a whirlpool of electrons, and, suddenly, our atom becomes more complicated than ever.'

The reader will excuse me if I do not go so far as the master who, plunging deeper and deeper into the problems of the internal thermo-dynamics of the atom, avers that 'the atom has no tendency to conform to the exterior temperature.'

Like Christopher Columbus in his stout caravel, this

scientist sails the waves of successive hypotheses toward the far-off horizons of the unknown. Like the great native of Genoa, supported by his unshakable courage, he is not daunted, but enraptured by the mathematical hypothesis. The law of large numbers, the calculus of probability, the 'a priori probability' of the transformations of the atom, cause him peculiar pleasure, in which his love of the mathematics of probability delights.¹

If there were an element of chance in the world, its laws would be without harmony. But, since the word signifies nothing more than a shortcoming of our intelligence, it consequently behooves us to understand what Poincaré tries to express, when he says that 'the atom of a radio-active substance is a universe, and, moreover, a universe subject to chance.' That can be nothing but an avowal of human ignorance before an apparent lack of coördination as yet inadequately explained. There is nothing new in the situation. How many recent explanations are little more than fresh paint on old faces! Chance has no place in our relative knowledge of the universe. Some things we know; some we do not.

Furthermore, because the atom in its transmutations seems to ignore the outside world, some persons have concluded that 'the universe of the atom is a closed universe, or, at least, one that is almost closed.' Can any one then forget that we know nothing of the universe except that its activities are interdependent? If we are not always in a position to determine what the links among those activities are, how can we say that they are non-existent, or nearly so? The way in which Poincaré ultimately develops his thought can change nothing. I leave to his genius the equipartition of energy and the still new *quantum* theory. He sums up his conclusion in these modest words: 'In the actual state of science, we can merely set forth these difficulties

¹ An interesting problem is whether we could not construct a scientific edifice solely with the help of the calculus of probabilities. By that path the unhappy Pascal found himself led to the argument of the 'bet' for his Divinity. I shall be excused if I prefer the broad avenue of observation and refuse to let myself be turned from it by the will-o'-the-wisps of a risky probabilism.

without offering any solution.' Such, as a matter of fact, has been, still is, and always will be the first provisional result of every attempt at knowledge. Theology and metaphysics find in the result something flattering to their vanity. And in that respect theologians and metaphysicians are decidedly childish, for we none the less succeed in reaching experimental proof, whereas they soar above the earth to no better purpose than turning useless somersaults like tumbler-pigeons, and to no other advantage than that of marking the ordered transitions from one state of 'disorder' to another.

AT THE HEART OF MOTION

We have not as yet been able to observe the formation of the atomic groups which we name molecules, and which owe their special character to their oscillations. We find ourselves, however, on the threshold of a molecular theory which will determine the structure of matter according to combinations of movement. In its three states — solid, liquid, and gaseous — discontinuous matter seems to be an agglomeration of molecules, the movement of which gives an appearance of continuity.¹ The molecules of solids are supposed merely to oscillate about equilibrium positions. In liquids, there is a wider range of sliding molecular movement. The volume is approximately constant, but the form, unlike the form in the case of solids, is variable. In the gases, cohesion becomes very weak, and the molecules, moving in straight lines, incessantly collide and either strike against any retaining surface or become diffused. The laws of their cohesion are unknown to us. All that we know is that those laws determine the degree of condensation, or of rarefaction. The *quantum* theory, now in great favor, would have it that molecular energy can travel only by bounds repeated according to an established *quantum*.

¹ In that case, what are the intervals, and how is action at a distance exercised? We invoke the elastic ether, by means of which discontinuity becomes discontinuous continuity or, if you prefer, alternate continuity. Many questions remain unanswered.

How can we connect the recognized activity of the atom both with the general activities that spring from it and with the activities that determined it? We must not expect a recent discovery to produce any prompt crop of verified observations. Following the second principle of thermodynamics, the so-called principle of Carnot, scientists have found it simpler to announce the disintegration of matter. And when the universe has been brought to 'thermic death,' we may as well pronounce the funeral oration of that energy which, implacable metaphysics notwithstanding, we have not been able, to this day, to separate from matter. One innovator has humorously referred to such theorizing as 'altitude sports.' Although I may accept my personal death in good part, I resign myself less easily to the death of the universe, because, in contradiction to everything that we can conceive, to assume the death of the universe is to assume that cosmic evolution is to stop. This supposition every accepted assumption of our scientific knowledge disputes. It is denied even by that hypothetical *entropy*, which I decline to accept because it implies an unknown form of cosmic disappearance in which, as I have already said, I can discover nothing except insufficient observation. Let us, therefore, forget our recent alarm, and give to such all-embracing problems the time needed for coördination.

To intrude upon the royal isolation of the old atom, and to recognize in it an aggregation of unexpected functions, required important discoveries which upset all our former conceptions of the physics of the universe. Scientifically observed phenomena have exacted new explanations, and if many of those explanations require reshaping, — which is the very condition of our knowledge, — we should not greet them with a *nescio vos*. Such a denial is no longer in harmony with the times.

I take the latest conquests of knowledge as I find them. The reader has been able to form a summary opinion thereof from my quotations from Rutherford, Perrin, and Poincaré. No one has the right to disregard the now universally accepted knowledge of the physical universe any more than he

has a right off-hand to decline to consider the bold explanations of these new scientific phenomena. No scientific novelty in history has so greatly troubled the inherited conservatism of obstinately closed minds.

The discovery of radium and of the continuous bombardment of its igneous corpuscles¹ has so stirred a public distinguished for its cultivated ignorance that it is not surprising if some alteration in the scientific conceptions of our physics has resulted. Thanks to the atavism of the average man, always in love with a chimerical fixity, inherited timidity (conspicuously a trait of religious people) checks an over-lively enthusiasm for new explanations.

Especially in the field of language, nothing embarrasses us more than the obligation laid on the innovator to express new ideas with old words the regular sense of which is forced to undergo the wrenching of an outworn phraseology. On the other hand, new expressions are perhaps fully as dangerous, for, under the stress of premature and scientifically untested notions they are subject to every kind of distortion.

In view of that unexpected phenomenon of electronic dissociation, over which a century or two of experiment may profitably pass, I am careful not to inquire too closely into the ultimate nature of the atom. Since we must recognize that the most exact observations lead us to electronic dissociation, let us regard the theory as established. But does that imply that the conclusions drawn from it need not be verified? Some persons claim that they have already been verified. Let them be further verified. The observer who always warns us against certain phases of the unknown must appraise at its true value the collaboration of successive centuries, equipped with all the means of investigation.

We should always guard against the constant errors into which words lead us, especially when we extend their

¹ 'The most powerful of modern laboratory equipment, the highest temperatures, the most intense cold, the greatest pressures, the most powerful chemicals or explosives or electric currents in no way affect either the radio-activity or the speed of radium. . . . 'The energy of a radio-active atom is two hundred and fifty thousand times greater than that of any other known atom.' (*Radium*, by Soddy.)

meaning in ways not always necessary, or even justified. How, for example, can I help being shocked when I hear Le Bon talk, as if it were something quite simple, of the 'dematerialization of matter'? Here, as Falstaff said, discretion is the better part of valor. We can never sufficiently mistrust absolute statements in respect to relative matters.

Although the atom used to be regarded as the ultimate form of matter, we now discover around its nucleus a group of negatively electrified corpuscles in course of dissociation. Radio-activity, which Le Bon considers to be a property common to all substances, is, in the case of radium, uranium, actinium, thorium, etc., a bombardment of tiny atoms, having a velocity of the same order as that of light, and producing definite effects on the bodies with which they come into contact. The radio-active rays pass through solid bodies; they give off heat and light, and set into action other phenomena which we see, but which we cannot always define. On the strength of this fact matter is said to 'disappear' and, we are gravely told, to have been 'dematerialized.' This would make our ancient creation reversible. Does a metaphysics of science drive us so far back along the road to chaos? Is there nothing beyond the electron? That is so far from the truth that impulsive generalizers willingly transmute dissociated matter into ether, that is, into something which is as yet unknown, but which, nevertheless, may be real.¹

From the scientific point of view, the experiments made on the rays emitted by radio-active substances gave Rutherford his nuclear theory of the atom; namely, the decomposition of the old unit of volume through the action of a nucleus positively charged with electricity. It is admitted that a variable number of negative electrons gravitate around the nucleus in fixed orbits, and that their gyrational

¹ For my part I incline toward that view. The *ether* is an integral part of our knowledge, in spite of having so far escaped the tests of observation. Now, having reached the end of our experimental knowledge of relationships, we are suddenly required to take the blind hurdle of an apparent 'dematerialization.' Among known and unknown cosmic transformations, why should there not be a fourth state of matter, and even many more than four?

velocity may wholly or partly liberate them from those laws of weight in which, under conditions unknown to us, the action of physical cohesion and of chemical affinity has its source. The number of negative electrons must be great enough to neutralize the positive charge of the nucleus. As in chemistry, we start from the atom of hydrogen — the lightest and the simplest of all — which consists of one electron only, gravitating around a nucleus of an equal and contrary charge, but having in comparison a very considerable mass. I will merely mention the curious theory of the formation and reintegration of the atom by the capture of electrons. In respect to that theory, we are in the halcyon days when hypotheses run riot. Some of them may, perhaps, produce results.¹

It is not easy for an ordinary man to find his way about in this confusion. It is true that we hear of a titanic intra-atomic energy, accumulated to an incalculable amount in the depths of the atom and ready to hurl forth its flaming corpuscles at a velocity of a hundred thousand kilometers a second. For what statements and predictions that remark is responsible! The incessant giving off of so-called 'intra-atomic' energy has been compared to the energy generated by the simultaneous explosion of the elements of a grain of powder. To be sure, those are two examples of the liberation of energy, but what of it? We are only on the threshold of the new phenomena, which have not exhausted the surprises they have in store for us. The greatest accumulation of energy in the smallest particle of matter seems, indeed, to be a fact based on observation, but that observation must be verified through a great amount of labor and during a great space of time.²

¹ I recommend any one who cares to go deeply into the study of these problems, to read three lectures by Niels Bohr, published in one volume, entitled: 'The Theory of Spectra and the Atomic Constitution.' In concluding his first lecture, Bohr declares that he wished to create in his listeners the impression that in time it will be possible to discover a certain coherence among the new ideas. At the point we have now reached, the realization of that hope is no longer in doubt.

² Similarly, I have expressed my suspicion of the famous distinction between

I have been obliged to recognize that the atom of to-day is not the atom of yesterday. What will the atom of to-morrow be? At present, the atom is beginning slightly to draw aside its veils. Some day, perhaps, the future atom will be revealed in the brightest light. Meanwhile, it may be wise not to take too much for granted.

As a result of the *quantum* theory, and in agreement with the idea of 'an atom of space,' some persons speak of 'an atom of time,' and 'an atom of energy.' To cap the climax we are now suddenly told of the 'dematerialization of matter,' which would lead us to 'thermic death' if we did not take the opportunity to 'materialize energy.' As long as I live I want to keep a bit of earth under my feet. For that purpose, I see nothing like clinging to the atom of to-day, such as we know it. As yet we cannot say that we have seen it, but we understand it to the extent that we can measure its nucleus and count the individual atoms in their usual motions. The modern atom is quite a different thing from the respectable old atom on which man based everything, and of which for that very reason he knew nothing.

To-day we know too much about the atom to resist the desire to say something about it. But it should be understood that the atom is neither the beginning nor the end of anything. It can be nothing but a transition (as is indicated by the admitted activity of its elements), in which, for lack of sufficient experimentation scientists have bumped their heads against a fantastic wall of 'degradation,' which represents nothing more than the result of exhausted imaginations.

By a surer method Rutherford explains the long evolution of the atom. And, if we were allowed to compare the various atoms of our actual planet with the atoms existing

the ponderable and the imponderable — a distinction that might be taken to imply an imaginary destruction of matter which no one dares to state in express terms. The word 'imponderable' can but emphasize, by its sterile negation, the inadequacy of our means of observation. The law of gravitation is not so easily managed — especially since the relativity of Einstein has opened for us new horizons on the relations between velocity and mass.

at various evolutionary stages of the nebula, we should undoubtedly be less quick to generalize about what we know, and about what we do not know.

We keep repeating that the atom and its electrons revolving in their orbits constitute a veritable solar system. The comparison was unexpected. But what deep significance may it not acquire if the organic bond between the atom and the solar system should happen to be discovered? Celestial mechanics, which is definitely recognized, implies a universal mechanics. Enormous masses, separated from us by bewildering distances, attract, or seem to attract, one another inversely as the square of the distance. Our sight, made more powerful by our own skill, discovers at the other extreme of the mystery, 'infinitely small masses named atoms progressing at distances that in relation to their size are no less enormous than those of the stars, and describing orbits in accordance with regular laws.' These are atoms. Like the real stars, they attract or repel one another, and that attraction or that repulsion, governed by the law common to both, depends solely on distance. 'The law by which this force varies as a function of the distance is not, perhaps, the law of Newton, but it is analogous to it.'¹ On the forms and degrees of that analogy depends the whole variety of the phenomena of the universe.

The atom, indifferent to the contempt of metaphysics and of theology, as well as to the glorification of natural philosophy, and become the god of the atheist in the collapse of Hellenistic polytheism, was offered to us as the key and the passport to the universe. That distinction it must resign. In the atom Pascal saw the pleasing vision of an identical formula for the activity of the infinitely large and of the infinitely small. That vision the electrons, rotating around the atomic nucleus, seem to make real. The atom has even had the glory of being blasphemed.²

¹ *La Valeur de la science*, Henri Poincaré.

² 'Some persons,' Bergson calmly writes, 'see the universe as a heap of matter, which imagination resolves into molecules and atoms. Nothing is more problematical than the existence of the atom.' (*Données immédiates de la con-*

The sanctuary of the atom, though not inaccessible, like that of Jahveh, is still strongly barricaded. The cave of the Cumæan Sibyl remains untenanted. The atom, which, unlike the Sibyl, cannot utter the last word about anything, merely shows us new phenomena that (with or without the permission of metaphysicians) are linked up with the cosmic system. Instead of being found at the root of things, it simply supplies us with the vision of a phenomenon among phenomena, and when we shall have clearly explained the consequent phenomenon, still another phenomenon will be patiently waiting in the antechambers of our knowledge until the door of the unknown opens at our knocking.

The task is not to make of the atom a Holy of Holies, the archetype of the world, the ultimate term of things, beyond which there is nothing. Nor is there, furthermore, any reason for setting up as sovereign of the Cosmos the metaphysical entity of an intra-atomic energy supposed to be a synthesis of all the others. Knowing too much, like the theologian, or never enough, like the scientist himself, are after all only two different forms, two different avowals, of the limit that relativity imposes. The seeker for absolute truth, condemned to struggle within the limits of his relativity, vainly pursues the 'last word' which a formula of infinity, lying beyond the scope of his intelligence, would supply.

Thus the word atom has seemed to too many persons to imply that science has reached a blind alley through its inability to go farther. That is what Vedism hinted at when it proclaimed that no one could say more of Universal Existence than that it is 'not this, and not that,' and that no one would ever be in a position to say what it is. The infinitely big and the infinitely little are all one. Consult Pascal. 'Whirlpool of stars or of atoms — we are as soon

science.) If the molecules, the presence of which the Brownian movement reveals to us, and Sir Ernest Rutherford's atoms talk together in the bosom of the nebula, I hope they are better informed of Bergson's existence than he is of theirs!

lost in one as in the other.' I have no other explanation of the world than this expression of human limitation: 'Such it is.' Atomic energy conceals no more secrets than does any other manifestation of energy. I can see no higher purpose in life than seeking to recognize the interlocking forms of that which is, as determined by their shifting relationships. Imagination takes the rest for its share. Even so, it must adapt itself to our 'realities.'¹

So it happened that the atom of yesterday, unable to claim any connection with science, was a brilliant philosophical prophecy. All antiquity agreed in recognizing in it a high speculative value. Natural philosophy imagined it, because it was needed as a hypothetical ultimate, and, as chance would have it, the atom was no sooner imagined than it appeared, no longer as the corner-stone of the structure of the universe, but as carrying that structure to new depths. Indeed, we may speculate whether, somewhere in the cosmic nest of boxes, our atomic solar system may not in its turn have a remote sub-nucleus around which gravitate sub-electrons, new cosmic elements into which series of intra-atomic solar sub-systems may fit indefinitely.

That seems hard to understand, but the stellar monsters, compared with which our sun is of imperceptible importance, make it clear that there are no directions or dimensions in which to plumb infinity. The two infinities of Pascal — which are but one — merely represent the windows through which our subjectivity looks toward the unknown. What do we know of any ultra-gaseous state of the substratum in the nebula or even in the sun? It would not be fitting to be too exacting about hypotheses regarding states of matter, since we admit the hypothetical ether, halfway between that which is and that which may not be. Before we had discovered the dynamics of the atom, its mass and its weight were currently discounted in modern

¹ I hope no one will class me as an 'agnostic' merely because I recognize that man cannot know everything. We can know, that is, classify, changes of relation. 'We think in terms of relations,' Herbert Spencer declares. Theology and metaphysics cannot be, and are not, anything more than the presumptuous clamor of abject ignorance.

chemistry, which even suggested an architecture of the atom, the specifications of which were subsequently to be adjusted to observed phenomena. Indeed, if the action of the ether has been theoretically admitted, direct observation will have its day, as happened in the case of Neptune, the existence of which was determined before the planet itself was seen. From that event, if it should occur, new light will be thrown upon the exact nature of the atom. Our fathers bequeathed us surprises, and we shall bequeath others to our sons.

MATTER, ENERGY

Where then do we stand in respect to the problem of matter and of energy? With a phraseology that under changing forms always dealt with entities, we stood even yesterday at the same point as the ancient philosophers. We kept, and we still keep two words — 'matter' and 'energy' — which seem to us to correspond to distinct aspects of phenomenology, and we do not conceive that it is possible to give them up.

Something exists. For us anything which resists us, or which strikes against us, is matter; and since we see it now apparently motionless and now moving, we imagine that it is moved by another something which we name divinity, genius, spirit, soul, force or energy. That stroke of analysis, with the dangerous help of the verbal mechanism of realized abstraction, has sufficed us to this day, and we have gone no farther than the verbal distinction between a substratum, theoretically assumed to be inert, and a force, abstractly conceived, which puts it into motion. The notion of something automotive, in which matter and energy cannot be objectively distinguished, seems to-day to be upsetting the metaphysical idea based on a merely verbal separation of two aspects of elementary activity and taking its rightful place as a conception having a basis in fact. Energy was supposed to have the duty of vitalizing matter, the business of which was 'to give real existence to energy.' That looked well enough in the professorial chair, but it ended in the

blind alley of the antinomy of the immobile in movement, not to speak of the dematerialization of matter, of thermic death, of entropy, and of I know not how many other monsters before which the imagination recoils in horror.

Science has necessarily tended to make energy impersonal. However, even to this day, it has left it the value of a metaphysical entity. But when we try to follow it in its manœuvres, it vanishes before our eyes. Some people say that 'the mass of the electron is nil.' Apparently that remark means that the mass reaches a point at which we can no longer distinguish it, and that, according to the principle of Carnot, the atom, reduced to being no more than 'a hole in the ether,' is about to be dissipated in the course of the dematerialization of that hole, or in other words, in the thermic death reached through entropy. Is it not evident that the new interpretations do not sufficiently coincide with the facts at present known to science? It would be miraculous if it were otherwise.

I do not purpose to go farther into the matter than the masters of modern science, who, making no secret of their perplexity, publicly clash hypothesis against hypothesis in the grim hope of striking therefrom some sparks of knowledge. Thus, we have already seen the atomic unit break up into other forms, electron, proton, and nucleus, only to progress towards new states of cosmic activity. We can even establish the great density of the nucleus, from which we can sometimes extract hydrogen, etc. As for the ether, it rests even now, as used to be the case with the atom, on logic, and for that reason we should at least accept it provisionally as the x by means of which we may some day succeed in co-ordinating new scientific discoveries.

Doubtless, metaphysicians ridicule us for basing a scientific doctrine on an element that has not been actually observed. The taunt would not be without importance if our experimental knowledge were anything but fragments obtained through observation and then inductively bound together. Have we not admitted our insufficiency? When I show that I have observed well on one point, why should

any one be astonished that I have not yet sufficiently observed on some other point? And why should any one, taking his text from the fact that I do not know everything, proclaim that I know nothing? Such is the easy artifice of the man who pretends to know everything before he has learned anything, and who cannot succeed in reconciling what he has himself inevitably experienced with the 'science' which he owes to his imagination.

Since the mechanism of the stars coincides with the mechanism of the planets, and since the mechanism of the planets coincides with the mechanism of the electrons, as experiment leads us to believe, we come to the conception of the identity of substance and of energy throughout time and space. The Cosmos can be no more than an eternal electronic phenomenon, the radiations of which, reflected on our sensitive surfaces as on a mirror, give our senses the opportunity to objectify them.

We were in search of a body that we could regard as the basic element of the world when suddenly the atom revealed itself as a system of bodies (?), each carrying an electric charge that, like the rotary movement of the planets around our sun, drives it into rotary movement around a nucleus. The only other thing we lack is a Newton who shall so extend the laws of gravitation that they will apply directly to the nucleus of the atom. Even now scientists are trying to show us the atomic bombardment throwing off electrons and ions into lines of forming molecules with a velocity¹ of which the Brownian movement is the repercussion. Since all the vibratory waves of the Cosmos are universally interdependent, it clearly follows that the atomic system is in strict correlation with the cosmic system into which it is fitted. The laboratories are at work, and it is already something gained that hypotheses are formulated even at the risk of having to be abandoned.

At this point, we encounter the problem of action from a distance, which, we are told, we must give up. Is, or

¹ The velocity is a thousand times the velocity of the planets, which move at a rate varying from sixty to a hundred kilometers a second.

is not, matter continuous; that is the question in its stark simplicity. The elastic ether, penetrating all bodies, assures the continuity of matter. However, if there are electrons in the ether, even though they are holes, they need space in which to perform their evolutions, and since, on the other hand, action at a distance seems to raise insoluble problems, the conflict goes on between atomism and etherism, between automatic mechanism and absolute continuism. Poincaré declares that the debate will never end.

Who knows? Like the atom, which was only a word until the discovery of radium, the ether may be the solution of our difficulty. Like the atom, it will perhaps have its day. However, atoms, which are separated from one another by a thousandth millionth part of a millimeter, are still apart, since they do not touch, and action from a distance remains as yet a formula based on no objective fact. Obviously, if the atom continues to be nothing but a hole, the ether must find it hard to establish the continuity of matter so as to assure the communication of energy. Even now we hear of matter that is still more subtle than ether, and there is no reason why ether should not exist at different degrees of condensation. In any case, we must ultimately come face to face with the action of the space or substance in which bodies exist.

The kinetic theory of gases, which leads us to the kinetic theory of liquids and even of solids, deals with swarms of molecules involved on all sides in successive and unending collisions. 'Thus,' Poincaré tells us, 'the molecules exchange velocities with one another, until they reach an average distribution of velocities which they maintain indefinitely.'¹ That smacks of a reconciliation of thermic death with motion.

Before the movements of molecules come the movements of atoms. Perrin can tell us how many atoms there are in a gram of hydrogen: six hundred and eighty-three thousand billions of billions. A different method of counting gives us a figure of six hundred and fifty thousand billions of billions,

¹ *Les Conceptions nouvelles de la matière.*

and still other methods lead to a similar result. I will not elaborate on the importance of those remarkable coincidences. So far as the movements of atoms are concerned, we can follow the spark of the atoms of helium as it separates from radium.

Poincaré draws the picture of a giant approaching us from the depths of the celestial abyss. Coming into the light of our Milky Way, he sees, even as he asks himself whether this luminous cloud is formed of atoms or of continuous matter, myriads of solar systems and believes he has found the atoms he seeks. Not at all. They are innumerable suns, the centers of planetary systems; that is, his immense telescope shows him identically the same spectacle that our microscope shows us when we examine the atomic suns and planets in revolutions similar to all cosmic revolutions. Around the central nucleus, the electrons describe their orbits in the same fashion as do the planets. 'All ionization,' writes Perrin, 'divides the atom, on the one hand, into one or into several negative corpuscles of insignificant size,' and, on the other, into a positive ion of relatively great weight, formed of the remainder of the atom. The atom, therefore, is not indivisible in the strict sense of the word and perhaps consists of a kind of positive sun — a nucleus with a permanent electrical charge — around which circles a swarm of negative planets which are the same in all atoms.'

After the fragments of the exploded atom have become new atoms, we can measure, not only their enormous velocity, but the ratio of their electric charge to their mass, since they are charged with negative electricity for the electron and with positive electricity for the nucleus. We may thus be said simultaneously to attain the extreme division both of matter and of energy. The electron may be regarded as an atom of electricity.¹ 'We cannot,' Perrin goes on, 'con-

¹ The mass of an electron is eighteen hundred and fifty times *smaller* than the mass of an atom of hydrogen.

² The ionized molecule of gas, that is, a molecule which has become the conductor of an electric current, is supposed to be separated into two parts, respectively positive and negative, which constitute the ions and the electrons.

sider an electron independently of the negative charge it carries. It is inseparable from that charge; it is constituted by that charge' — which is equivalent to saying, if I really understand it, that matter and energy can be considered independently of each other without falling into quantitative correspondences. We approach the *quantum* theory that, with its grains of electricity, and with its grains of light, may thus temporarily be regarded as the possibly ultimate formula of individuation.

No one explains how those charges are placed in the atom or how they are discharged. I am not surprised at the omission, since it involves nothing less than the almost insoluble question of the ultimate relation between matter and energy. The word 'charge' is a metaphor intended to express a phase of phenomenology of which we are ignorant.

On the whole, the atomic structure of electricity can be regarded as established. In the same way, light is corpuscular, even while it remains undulatory. 'These grains, these projectiles of light, that we name photons,' Perrin tells us, 'can, like the atoms of electricity, transmit their energy to matter.'¹ And Langevin comes nearer still to identifying the two terms when he proves that light has weight.² In the same way, in Einstein's theory of special relativity, we are told that energy has mass and weight. If 'matter' is transformed when it gives off 'energy,' it must simultaneously lose mass, which takes flight along with the light emitted through the radiation of materialized energy.

¹ This is almost an identification of matter with energy.

² As a matter of fact, experiments in radio-activity prove that the atom of helium is formed by the agglomeration of four atoms of hydrogen. The atomic weight of those gases should therefore be, according to Lavoisier, as 1 to 4. Experiments now prove that they are as 1 to 3.96, the loss in mass, .04, corresponding to the energy that causes the transmutation of hydrogen into helium. The quantity seems insignificant. Perrin, nevertheless, sees in that release of energy something to explain the origin of solar heat and the development of that heat during one hundred thousand million years. Although the phenomenon is of a different order, we cannot help noticing the variability of the mass (in spite of Lavoisier), when we compare the diminution of the mass through radiation with the increase of that same mass when we give it a greater and greater velocity (the Lorentz-Einstein formula).

'Proton is the name given to the nucleus of hydrogen, which with the electron suffices to make all nuclei. . . . Electrons and protons, which are very different in mass, are the ultimate constituents of all matter. Having arrived at that point, we may perhaps wisely reserve some part of the unknown for the future.'¹ There can be no argument about that.

Finally, I ought to call attention to Perrin's impressive hypothesis, according to which the death and the birth of atoms may be supposed to follow in an order sufficiently definite to permit the regeneration of an atom of original hydrogen through the collision of an electron with a proton. 'You can see,' says that eminent physicist, 'how I think it necessary to interpret the remarkable experiments in which Rutherford succeeded in extracting hydrogen from various nuclei. I think that those experiments do not, as he has assured us, comport with any disintegration of atoms, but that, on the contrary, they are the first examples of an integration of atoms, with a total release of energy in excess of the energy supplied. . . . Thus, as on a much more modest scale we do in burning charcoal, we should be hastening, to our own advantage, the formation of heavy atoms at the expense of the light atoms still existing on our earth. Compared with that discovery, the discovery of fire may be considered as a small matter in the history of humanity.' And farther on he adds: 'In any case, we have reached a new conception of the evolution of the universe. The universe may be supposed to have been formed of hydrogen, rarefied to an amazing degree. During highly unequal periods of duration . . . that matter slowly agglomerated into huge pre-galactic clouds. In each cloud the hydrogen gathered into nebulae and then, as fast as the heavy atoms formed, into the suns that make up the "milky way." That condensation into ultimately extinguished suns made of heavier and heavier atoms may have extended, or may extend, over some trillions of years.'

¹ Jean Perrin, *Les Atomes*.

The reader will understand why I refrain from comment on such a point. After having listened to Perrin, we should be allowed time in which to catch our breath — a process all the more needful since all of a sudden disintegration of matter is finally converted into integration. Any one can foresee the fate of entropy.

Can we, then, regard it as finally settled that the atom is not a substance? Complicated calculations show that its mass is nil. Therefore, it may be said to be nothing but an electro-magnetic appearance provoked by a shift of position of the electric charge in the surrounding ether. Lavoisier had 'demonstrated' the invariability of mass. It is now admitted that the mass increases with the velocity, at the expense of the continuous medium which the ether supplies. As ether is not as yet visible under the lens of the ultra-microscope, we do not even to-day know its reactions.

Accordingly, as happens in every investigation, all that we know of matter and energy reduces itself to a group of verified observations and of hypotheses — sometimes contradictory — which require verification. The fact may shock the masters of the absolute, but for us simple mortals it is precisely that group of positive explanations which, carried to the point at which doubt begins, makes the value of our knowledge.

To-day, the irrepressible development of our minds, together with the exhaustion of abstract scholasticism at a time when scientific observation boldly takes its place in the front line of the battle for the improvement of knowledge, brings us back to a problem that, though new in form, is the old one of substance and force, always debated, but never solved. Even if that problem were insoluble by man, we could not worthily decline a debate in the depths of which something may be hidden that will partly supply a never superfluous intellectual alleviation.

No proposition made by man, no matter what it is, can be dogmatically denied, still less imposed. In the

field of positive science, who can tell the decisive value for the future of a well-placed *yes* or *no*? Partial victories may prepare partial defeats, and *vice versa*. The quarrels of scholasticism seem futile to us to-day because our lives assume different intellectual and emotional forms. The query whether categories or species were nominal or real no longer raises the passions of the multitude, or even of the élite. It is no less true that the question what is fundamental is logically implicit in it, and that in the crises of life and death the greatest minds bring to it the most intense passions of humanity. The world has changed, has 'evolved.' Owing to laborious research, which will continue as long as we live, the same fundamental questions, as modified by new knowledge, present themselves for debate in forms which indicate that we have made considerable progress toward the conquest of the unknown.

Metaphysics will never produce anything but tautological verbiage, for entities are only a repetition of the problem, which they dismiss, but do not solve. Therefore, we must always turn to scientific observation, if we are to discipline thought. Since our knowledge most often proceeds from corrected misconceptions, the problem of matter and energy is becoming precise, thanks to experimental data which at least permit us to state it more clearly. Does the problem really present itself in the terms under which we are accustomed to consider it? Can the conception of an entity of *motionless matter*, and of an entity '*motion*' which throws it into action, be consonant with the nature of things? We can no longer affirm it, as we used to find it so simple to do in other days.

Does the universe consist of motion? Can we, within the limitations of our intellectual organism, conceive movement as independent of *something* that moves? Can we define that *something* which we have provisionally named matter as in its nature motionless until the arrival of a motive energy which cannot be conceived of as isolated? Dissociated by means of abstract words, matter and energy afford us nothing but metaphysical entities with which we

try to build up explanations of the activities of the universe.¹

The grain of light transformed into a projectile of light; the electron transformed into an atom of electricity, and the atomic mass unexpectedly disappearing and leaving us face to face with all the problems raised by the ether, are indicative of the new path in which the bold physicist must walk. The reader can find not only a catalogue, but a discussion of the scientific hypotheses bearing on these problems, in the remarkable work of Louis Rougier: 'La Matérialisation de l'Énergie.' The principal point made by the author is this: matter, being 'endowed with mass, weight in proportion to its mass, and structure; and energy, having no inertia, no weight and no structure,' the question is how they can act upon each other. Using Einstein's theory of relativity and Planck's theory of *quanta*, Rougier proceeds to endow energy with everything that until now it has lacked — mass, inertia, structure — granting which the problem of interaction is solved. That is what he calls 'the materialization of energy.' Thus, the principle of 'no energy without matter, no matter without energy' may be regarded as saved. We should, therefore, correct the fault of language which forces on us two names for the same thing. Rougier does not go to that length.²

In that same spirit, the greatest physicists have tried in turn, but without appreciable results, to reduce force to mass and mass to force. A very notable attempt is, nevertheless, to be found in Ostwald's 'Energetics,' in which the author declares: 'Independently of time and of space, energy is the single magnitude common to every kind of phenomenon.' And again: 'All we know of exterior reality is the exchange of energy, and every physical phenomenon can be described in terms of energy. Conse-

¹ For brevity's sake, I say nothing of inertia, which is conceived of as resistance to motion, and which, after all, can be nothing more than an ultimate form of least motion.

² However, since his performance, as the very title of his work proves, consists of giving back to matter and to energy what their separation had taken from them, it seems that the uncertainty cannot last much longer.

quently, the concept of matter is included within the wider concept of energy, and the principle of the conservation of mass is included in the more universal principle of the conservation of energy.'

However, if, as Rougier says, bodies reduce themselves to complexes of energy, energy being nothing but 'the determinant of motion which assumes a shifting of mass,' is it quite certain that we have done anything more than shuffle words? I understand lodging mass within energy, but if, as there is reason to believe, energy and matter are one and the same thing, the materialization of energy and the energizing of matter are still only two aspects of the same automatic action, the analysis of which is still in the elementary stage.

I apologize for expressing myself so freely, in the ingenuousness of my ignorance, in answer to scientifically trained men. But science should make itself clearer to men of ordinary intelligence, especially in the field of hypothesis, where the most expert admittedly stumble. Rougier's conclusion, perhaps a shade too literary, suggests that we regard ourselves as bubbles of ether in nothingness. Mathematicians sometimes take pleasure in putting us off the track. Rougier has never seen ether¹ — even in the form of a bubble — any more than he has seen nothingness. For the present, then, I shall be content with a flash of imaginative knowledge, clearer evidence of which no one can better give than Rougier.

If the explanation of the relations between matter and energy is summed up when we say that they are two aspects of a single element dissociated by language, what conclusion can we draw except that verbal analysis vitiated our first attempts at understanding the problem? With Le Bon, I suggest that we leave untouched that part of the unknown which inevitably enters into what we think we know. The tilt between Newton and Einstein seems to suggest that procedure. The investigator follows the law of

¹ Let us not forget, however, that Fresnel has *almost* seen ether in the undulations of fogs which 'may have come' from the meeting of the tops of luminous waves. Query.

his enthusiasm. Scientific criticism will set back into the right path whoever may have wished to prove too much. Such is the strength and the weakness of a relative organism which can function only through the rectification of error.

Can we discover in the atom in action anything other than a manifestation of energy and matter, developing the intensified motion of the Cosmos in endless oscillations between concentration and dispersion? It is a signal victory to have made atoms appear to us as trails of sparks which, passing through solid bodies at a speed of from thirty to a hundred thousand kilometers a second, make the air conduct electricity, and which are turned aside by a magnetic field. But how are we to cope with the composition of cosmic activity in the intimate drama of matter and energy which leaves the indeterminable to those who dream of grasping infinity?

If ether is matter, the dissociation and reintegration of the atom are no more than changes of state, that is, the upsetting and restoring of equilibria, neither more nor less significant than any other changes of the sort. The nebular hypothesis, as Laplace states it, implies successive states of matter, the coördinations of which suggest corresponding effects of energy — a fact that reduces every cosmic problem to the same terms, no matter what kind of motion is in question.

Since Lavoisier it has been thought that matter is indestructible, and Newton taught us the conservation of energy. I am not inclined to give up those principles without extremely good reasons. The basis of this sharp dispute over terms is an imperative desire — easy to understand, but impossible to satisfy — to secure (in order to attain complete understanding) a synthetic formula of the universe and of ourselves which will permit us to take our bearings in the ocean of the absolute. Such, for the common run of men to-day, is the principal function of our current God. From sickly souls still comes a flood of idealism which appeals to the less intelligent, and which is broken by the cries of

that terrestrial and ultra-terrestrial suffering in which the divine love for man delights.

Religious observances — which, perhaps, contained *in petto* an element of unformulated doubt — always resulted in strengthening the fragile structures of misconceptions in which men of the past excusably lived. Even beyond the lure of the social consideration which those observances win from the common weakness, there exists the incomparable advantage for every one of finding himself in a position to 'know' and to tell everything about the world, without making any experimental effort, or even any personal intellectual effort. Contrast with them our unfortunate scientists who have to butt their heads against the bastions of the unknown. Divinity filled the precious office of teaching the universal password to black ignorance and to befogged misconception. We might properly suppose that the secret of matter and of energy was hidden behind the altar, yet no one sought it there. The crude mystery of a dead language was enough to give the puerile adornment of emotion to our sense of the incomprehensible, which was artfully substituted for the unknown. Imaginative answers were returned to unprofitable 'wherefores,' while despised observation exhausted its efforts in the commonplace search for the 'how.'

Furthermore, the origin and the end of things, two words which scientifically have no meaning, became one to the stupid true believer, who sought a world made for the human race, and who was condemned to 'think' before he learned. Undoubtedly, one must learn in order to know; one must submit to painful doubt, and the doors of phenomena must be forced, even though mere doubt is considered the supreme crime, and punished throughout eternity. How much simpler than thinking it was mechanically to repeat words devoid of any positive significance, but full of a magic that was a safeguard against eternal fire!

As a result of that state of mind, our 'mental progress' continued to maintain Moses in the ministry of the unknow-

able,¹ that is, in the rudiments of a vitiated culture. For indeed, we do not see that any prophet recommended an attempt at scientific knowledge, the nature and interest of which no prophet could grasp. Later, the cosmologies of Copernicus, of Kepler, and of Galileo corrected the errors of the Mosaic God. Now, after the cosmogony of Laplace and the evolution of the atom, a conception is offered to us of a cosmic government that is linked together from the ultra-dispersed matter-energy of the nebula to the planetary condensation, the extent of which has the splendor of all unlimited possibilities. The phases of the planets mark points of progress, just as the geological strata indicate planetary transformation. That moment about which so much fuss has been made is but an instant in the famous 'cycle of the universe' and to that eternal universe has no more importance than any other instant.

The unbreakable connection of phenomena, such as science reveals it, requires cycles of ever-increasing number and amplitude, since nothing less is in question than filling infinity. Many scientists, philosophers, theologians, and metaphysicians, infatuated with words, have at times believed that they had grasped some parts of those orbits which are beyond our capacity to measure. Ideology was sure to be at the spot where, by joining hypothesis to hypothesis, the two ends of the circle are made to meet.² With increased knowledge the expanse of darkness will disappear before us, and unexpected problems, like those of the atom, will develop to provide our intelligence with new forms of pleasure and with new perplexities. Without prejudice to the future, let us accept things as they are. No matter to what unforeseen developments the elements may invite us, we can help to determine their relationships by using our knowledge. Nothing begins; nothing ends; every-

¹ To-day we should be able to choose between Moses and Laplace. But to do so overtaxes the courage of the weak. They prefer to side now with one and now with the other. Let him whom the cap fits wear it.

² The unknown orbit in which the sun is dragging us in the direction of Hercules is entirely insignificant in comparison with numberless other immeasurable orbits of the infinite spaces.

thing continues. Though we have renounced the fictitious compensations offered by theology, we nevertheless retain a powerful longing for something that will compensate us for our insufficiencies. Every event which reaches us from the universe will be a new incentive more completely to adapt ourselves to that universe.

The pure scientist, disdainful of a 'popularization' that seems to him derogatory to science, is glad to content himself with the secret joys of his interminable research. And yet, whether he knows it or not, it is for the masses that he works. He would be a squirrel revolving in a cage, were it not for the consciousness of that human approbation which is a favorable augury of the course of the future.

However, the popularizer, too easily diverted from those matters which preoccupy us by his search for an audience, less qualified, perhaps, than our academic coteries but more accessible to emotion, still finds himself rendering good service to science in the arduous task of forming intelligences, by preparing them for new ways of thought. In that sense, the rôle of the pupil is as fine as that of the teacher, for all that crowd of learners is held together by an identical enthusiasm evoked by an identical desire to preserve the ideal that is its guiding star. Far from wishing to disparage the untutored public, I maintain that even its inadequate mental reactions bear honorable witness to an aspiration superior to its ability. Hence comes the urgent need of supplying it as soon as possible with the means of rising to a higher plane.

All men, though differing endlessly in their interpretations of the universe and of themselves, might thus experience in common the thrill of greatness, each in proportion to the development of his capacity, the law of which is that subjective discords must be objectively harmonized. No effort is lost; does not that fact encourage us to labor? We attain harmony even in the adjustment of our inherited impediments, which must ultimately be overcome. May we not consider the indifference of the universe as the most beautiful background possible for our sensibility?

THE POEM

Amid the indifference of the universe, the diffused sensibility of which condenses in diversely related organic pain or pleasure, there flows the dramatic adventure of ephemeral lives in which our relativity opposes the irreversible current of things only to be submerged by it. However our inherited weakness may cling to the dream of another world — a world wherein suffering is either abolished or intensified — we remain at grips with the universe in which we live. Should human intelligence surrender to the puerile decree that tries to substitute an hallucination for elementary facts? The pontiff demands the sacrifice, and even attempts to impose his frail commands by threats of suffering in this world and in the next. Against the pontiff, the follower of experimental science sets up his pragmatic investigation of the universe. The crowd, uncertain of its choice, vacillates while it waits for something — it knows not what — to happen.

The question is whether we shall create for ourselves joys founded on ignorance or whether, accepting contact with the elements, we shall draw therefrom a manly energy which will awaken the impulse toward a higher life. And at that point a will capable of imposing itself will make its decision. Shall we choose the noble elevation of the idea, or shall we accept the tame servitude of human weakness in the expectation of an everlasting reward which words cannot express?

The symbolic Antæus, in his great struggle against the gods of Olympus, recovered his strength whenever he touched his mother the Earth. So will it befall us, if we will truly live in the splendor of our human poem. That poem has varied. It has had, it has, it will have its evolution. Its first effort went no farther than the actual realization of a 'garden' — if I dared, I should say a kitchen-garden. At Paradenya near Kandi, and also at Buitenzorg¹ in Java I have seen the Asiatic wonder of an attempt at an earthly

¹ 'Sans Souci.' The name clearly reveals a deep desire to be free from earthly cares.

reconstruction of the ancient Paradise — 'the garden of the Eternal.' Every wonder of the floral kingdom (and a serpent always lurks under the flowers¹) is present to create an ever increasing astonishment which ends in a sense of the impotence of man, when confronted with his dream of mystical greatness — a dream no sooner realized than found to be a sham. Without artificial arrangement, wild tufts of verdure and uncultivated trees of the jungle are by nature better fitted to evoke the elemental powers than are all our metaphysical twists and turns of mistaken interpretation. We must give up the Garden of Eden which in the absence of Biblical man nothing can restore, and seek our ideal, not in dreams but in knowledge.

At Ceylon, amid the thickets of Anuradhapura, the old stone Buddha has for ages awaited the man who dared question him. Sometimes it happens that an ape, unmoved in his ingenuous impudence, looks into the eyes of the Master and demands an interview of reciprocal silence, more suggestive than the finest sermons of the great visionary monk.

On the strength of the Buddhistic inscriptions on the Cingalese mainland, I wanted to study the lofty revelations that the monks to whom, under the auspices of Mahinda, son of the great Asoka, had been confided the task of providing for the salvation of this earth, had left to future generations.

When I set foot on the flat surface of the sacred rock on which the noble writing was displayed, what chagrin was mine to find that the good monks were interested in nothing except how to establish title to the neighboring pool, whose

¹ The superintendent of Paradenya pointed out to me a large snake quietly leaving the water and leisurely crawling to a nearby clump of bushes.

'Is it poisonous?' I asked.

'It is not one of the most poisonous, but it is not harmless.'

'And you let it go?'

'We never interfere with them. They know it and do not trouble us. The thickets which we have just passed are full of them. They do not resent our presence. We are friends.'

The truth is that the Indian, who as a matter of doctrine must not inflict death, has preserved from the ancient legends a religious respect for the serpent, and I rather believe that the venomous reptile is not insensible to the innumerable proofs that he has had of that sentiment.

waters could be profitably sold for the cultivation of the rice fields! It was a disillusion which, thanks to the amiable silence of the Buddha, the friendly ape was spared.

So much misunderstanding explains only too well the bold idea of the Florentine, the explorer of hell, when, impatient of mystery, he resolved to examine the dark substructure of human destiny. In the fateful bark, the picture of which a great romantic painter has left us, the adventurous genius, with his stately poet as guide, fearlessly entrusts himself to the somber and choppy waves in his effort to attain the deceptive headlands of the unknown. In vain do they who have been wrecked cling like Cynægirus at Marathon with tooth and nail to the skiff, which floats toward the baneful shore. Searching with his eyes the stormy elements, the singer of Mantua urges perseverance in braving the terrors of the crossing. What matter the fogs of a world, from which the transient dwellers have reached the open sea? Regardless of risk, we must sail on. As befell the famous Genoan, whose misunderstanding of his problem cast him on the unexpected shores of the New World, the insecure planks of the perilous ship carry us to ever new conceptions of the ever marvelous and ever elusive unknown. What safety is there in the sand in which the anchor may chance to bite? Already we read the ominous inscription: 'All hope abandon, ye who enter here.' There is but one possible answer: 'Enter!'

What! endless suffering intensified to an impossible degree under a sky which continues to promise no respite! Not even the prospect of an end! Implacability that never ceases! At least at certain times, human barbarity loses its fierceness, be it through fatigue, or through lack of interest. That is never true of divine barbarity. There is no ship to carry us to some charitable shore, where the powers above are indifferent, and may chance to forget us.

Having asked the impossible boon of flawless happiness, man sought to record some of his terrors on the locked doors of the unknown. Called upon to attain the ideal, what could man do if, in the unending pursuit of an ever antici-

pated but ever receding infinity, the finer part of that ideal was never to be realized? Was he to abandon his hopes? Must we, then, resign the joy of making for ourselves a greater place on earth by our own initiative? The magnetic field of self-confidence, the best of which is exhausted in demanding help of the Divinity, can produce nothing except the stupor of inertia. The opposition of rebellious circumstances and every form of the sadness of things are needed as a take-off for the great flight.

The bold pilgrim in search of knowledge, on returning from the night of the infernal regions, again beheld that enchanting vault across which flame whirlwinds of incalculable energy throw out into time and space every temptation to know and to mistake, all enthusiasms, all despair, every chance of joy or of suffering that makes the good and the evil of our destiny. Either to live in the fullness of life, or to turn away — that is our sole alternative. To march forward is to will. Hence, it behooves us of the modern world to answer the challenge of the poet of evil with the encouraging watchword of human knowledge: 'Ye who emerge from the abyss, hope on.'

To hope is to live, to will, and to act according to the nature of things rather than to wrap ourselves in a hollow cocoon of an undescribed and indescribable supernatural. Relay after relay, all the opportunities of the never-ending moments present themselves — moments in which the interdependent elements prepare to produce new compounds of energy with their resultant new effects. The phantoms of myths follow one another only to disappear under the cross-fire of knowledge. In spite of the idle beauty of chimerical dreams, science lights the fathomless deeps! Such men as Copernicus, Galileo, Newton and Lamarck, noble exemplars of the noblest humanity, taste the sublime emotion evoked by the extremes of suffering and of joy.

Contours shift; colors flash. All the lines of the spectrum separate or blend, yet never exhaust the unexpected. Oceans of waves cross one another, or meet and harmonize.

Amid the suavity or the tumult of the indescribable symphony, man, astounded by himself, loses his bearings in terror before a cosmic greatness beyond the reach of his weak senses.

But, after oscillating between an objective universe and a maximum human subjectivity governed by the purely organic processes of a 'knowledge' beginning and ending in emotion, man finds that the hour has come when he can stand erect. Between the star and the atom stretches a *via sacra* of knowledge. There is a magic in height and a magic in depth. Impatient not to be left behind, imagination kindles into flame. Do we at last hold the secret of the universe? No. The atom no more holds the secret of the elements than does any other phenomenon. We have already gone beyond the atom, and we cannot doubt that elements succeed one another even to infinity.

That there is an ultimate cosmic element is an outworn conception — whether it be represented by a 'Creator' or by an 'energy-matter' on which rests the structure of the universe. In the progress of our relative knowledge we have been able to discover nothing but uninterrupted succession. And when we seek, as the end of man, a hell or a paradise impossible to install in time or in space, history reverses itself, and the 'Holy Inquisition' is summoned to appear before the court of Galileo. The scientist, once struck to earth, rises to his feet and unexpectedly demands an accounting from him who exacted one. Long before Alighieri, the man who was anxious to learn had entered into the heart of the universal drama, and even if he was not permitted to fathom the unfathomable, he could still reply to the stammering visionary: 'I wished to see, and I have seen.'

CHAPTER XI

OUR PLANET

LAND! LAND!

ONCE we have left the stars behind we must land, that is, we must so take possession of our planetary dwelling-place as best to accommodate it and ourselves to our capacities, needs, and desires. Even so, in such a scheme imagination plays a greater part than one might think, since, from the remotest nebula from which we derived to the superior achievements of our earthly lives, our positive knowledge of life amounts to nothing but a series of universal waves, fictitiously made real by giving them names. Such is the status of man in the Cosmos, which in the last analysis is nothing but a vast gyration of atoms in the world and in the sky, far beyond the limits of our vision, through which what we term sensations pass like flashes of lightning.

To the man of average intelligence this seems a paltry sum total of knowledge. It is nevertheless an important landmark in the development of human mentality. We can learn only by studying our organic reactions, and we must be careful not to attach to mere words any significance other than a means of identification. Because we did not take due care to avoid this mistake, we have ensconced ourselves in a niche of chimerical verbalism from which recently developed scientific methods are gradually dislodging us. By way of simile we might say that the moth singed its wings because it sought more than light when it fluttered around the candle.

If the universe is constantly changing, the same must be true of the fate of man, who is a part of that universe. The natural error of man's first conception lay in the fact that he tried to localize the equilibrium of the world in an omnipotent personality and to regard himself as permanent and stationary because of his 'soul' — relative because it was

born with him, but absolute because it was immortal. We must beware not to commit ourselves to the obsolete conception of a universal consciousness, supposed to be identical with the Cosmos, and for that very reason unable to become objective in view of the relativity of the human race.¹

The unity of matter and, consequently, of energy, which cannot be separated therefrom, seems to be the hypothesis towards which, at least to-day, modern science is tending. This throws no light on the theory of cosmic finality, since subjective classification by no means necessarily implies a corresponding objectivity in relation to infinity. If it did, the atom, over-charged with energy, would become, as a substitute for a conscious divinity, merely the symbol of a reservoir of unconscious energy, not incompatible with pantheism. Such is not the case. Science explains the situation as a rapid-fire of atomic particles, thanks to which the complexities of molecular movements show reactions of sensibility which permit us to appreciate that the elements are in perpetual activity.

The fate of the world, of which because of our elementary nature we are a permanent part, was a matter of complete indifference to us before we were born. And it will again become indifferent to us the moment we are dead. Before birth as after death our pains and our joys are fused in the universal evolution which produced them. The problem of a man, conscious of himself, who has embarked in no matter what capacity on the voyage of life, is to play his part well as a member of the ship's company, and if the ocean frightens him, he must not become ridiculous by being afraid to make port.

In the remarkable confusion, in which good and evil walk hand in hand, various evolutions, which nothing can halt, have thrown the whole atomic world of our blazing nebula into condensations, due to a process of cooling, which supply a harbor of refuge for our new-born sensations

¹ What would God amount to without his 'creation'? Having no reason for existing, or for any activity, he had, until the moment of 'creation,' to be self-sufficient. Why did he not continue so?

— a harbor of which the breakwaters will save us from shipwreck at least temporarily. The lookout has sighted land; every one is on deck, glasses in hand. They behold now an iron-bound coast, now inviting beaches guarded by dangerous reefs; beyond, are barren mountains rising to the clouds and fertile plains through which valleys pay to the ocean the tribute of their streams. All the vagaries of life's joys and woes are there. They are, as it were, a harbor of fears and hopes. Let us go ashore.

TERRA FIRMA — A FROZEN TUMULT

After our buffeting on the seas of the unknown we are promised a rest on solid ground. Throughout centuries without number, passing from surprise to surprise, we explored our new abode in company with our inarticulate ancestors, and we did not, nor did they, trouble to ask many questions beyond those necessary to effect an immediately satisfactory state of existence. As Lamarck so truly said: 'We contracted habits.'¹ Some of them ended in stereotyped behavior; others, and therein we were very fortunate, produced more acute sensibility and keener understanding. Owing to them we developed into our present state, which allows us to examine ourselves scientifically.

Present-day man is the result of successive imbricated states of knowledge which have made him, and which keep him, as we know him. He is worth his face value. As far as we can see, he is the product of universal laws, manifested in him by the organic complexes of his alternate acceptance and rebellion. This contradiction becomes constantly more pronounced, and man in turn becomes a succession of absolutely predetermined interdependent activities.

We have reached a point in our knowledge of the history of the world where we can grasp a few of the chief epochs in the development of our planet, and where we can actually reconstruct the sequences of even earlier phenomena of

¹ Habits are repeated reflex actions, automatically connected, which produce organic growth through constant exercise.

which our globe is the product. From the moment when the burning sun threw our world like a cannon ball into space, the gradual cooling process created conditions which formed the foundations on which our existence is based. In a summary way we can to-day classify the major geological formations of our planet, and these in turn subdivide themselves into other important forms. For a long time some sixty were recognized, which it is unnecessary to describe or to enumerate. To-day we know of over a hundred; doubtless the number will increase, although, in fact, all are really one, since all are the result of the same cause.

In the dawn of the geological era, the length of the periods of condensation and the movements of the earth's crust due to the inequality of the cooling and solidifying masses are for us incalculable. We have no positive information concerning the history of the fragment of solar star in process of becoming a planet. From the time when our globe takes its place in the cycle of history, it gives various interesting indications, but no definite facts in respect to the time that its changes took. The different phases of cooling, and the resulting movements upon and below the surface of the world, as well as the shocks due to water and to heat, have been the subject of characteristic inductions founded on observations of conditions which must have existed prior to the first manifestations of life.

The earliest effect of cooling through radiation was a fatal flood which occurred just as soon as the temperature dropped to a point when the chaotic atmosphere made it possible for heavy clouds to condense into the water which, in turn, became a raging ocean. There resulted a formidable envelope of seething seas, rising in mountains of foam, from which huge heaps of lava rose, only to collapse as soon as they appeared, to the accompaniment of a Titanic cannonade. Such was the transition from the early nebula to a world wherein indescribable powers contended among themselves.

The invasion of the water continued without respite; undeterred by temporary checks, it fell from the sky in

steaming rain; it eroded the rocks, threw aside all obstacles which it found in its path, dug chasms only to fill them immediately and rose to the sky in clouds of thundering steam only to fall and go through the whole process once and again. This process Biblical ingenuity termed 'dividing the upper from the nether waters' — quite ignorant of the fact that both waters were the same, and that their function is forever to exchange places.

Dissolving and absorbing everything it met, the water of those days, because of its tremendous content of clay, was not, and could not have been, in any way similar to the calm waters which we know. Huge and raging torrents and overflows from irruptions leveled precipices and mountain ranges and filled up valleys where streams carried away again the deposits which they had previously made. For a period which we have no means of measuring, and which was interrupted by unknown upheavals, the whole globe, torn by extremely violent disturbances interspersed with temporary lulls, was under water.

One must not expect to draw a series of pictures depicting what to our paltry methods of measurement is incommensurable. In their ignorance, men of ancient times sought to define their vague hypotheses of cosmic upheavals by the word 'chaos,' which to them signified the inconceivable.¹ The wars waged by the Titans against the powers of order are an echo of a world barely glimpsed; and from them grew, in the form of legends, the first terrors at the last echoes of a universal convulsion.

To-day we know that nowhere can there possibly be any break in cosmic coherence. The turmoil of the elements is only a coördination of phenomena which precede and of phenomena which follow. We must admit, however, that the sequence of these successive movements in the 'relation of things' and the procession of formations which broke up

¹ The friction of the tides, drawn forward and back by the sun and by the moon, slowly decreases the speed at which the world revolves. What will be the outcome? Some one has predicted a day and a night each a year long. Such a development could not take place without greatly altering our present conditions of existence.

as soon as formed were bound to baffle our first attempts at coördination. These huge masses of clay, created by the surges of fire and of water in which all cosmic combinations were manifested, achieved, after thousands of millions of years or of centuries, the supreme miracle of life and through life of thought — that is, our consciousness of our relative position. To determine the sequence before we can scientifically construct an ordered synthesis thereof requires on our part a tremendous subjective effort in our bewildered state.

The most ancient science is astronomy. In spite of the fact that it was a science, people childishly connected human destinies with it, and men of outstanding intelligence went astray among astrological chimeras which, to-day, make us smile. It is another case of stubborn resistance to new discoveries bearing on the life-history of our planet. What a hue and cry was raised when, scientific examination of certain parts of the earth having told a story in which there was no room for the fables of Moses, remains of man's handiwork and of man himself — to the great scandal of the Churches and the Schools — brought conclusive proofs which people had finally to accept, though at first they damned them. Nor should we forget that the event occurred in modern times.

Once under way, nothing can check scientific investigation. We are to-day in possession of an authentic history of our tiny, yet magnificent, planet whose action makes itself felt far beyond the farthest visible star which stands guard on the border of what we term 'infinite space.' The shape, the size, and the substance of the world, with its changing atmosphere, its moving oceans, rocks, and alluvial deposits, in which every phase of life takes place, even to the reactions of human thought in its relation to the Cosmos and to universal movements, are conceptions of a very different caliber from those with which theology and metaphysics tried to satisfy our inquiries.

While we must be content to estimate the age of the stars from the color changes they undergo and to deduce from an

analysis of light-rays the stages of stellar evolution, our earth, extinct and cold on the surface, is available for our investigations and, without overmuch trouble on our part, provides us with the sequence of events which it is our function to adjust to the general laws of the ultra-solar universe.

We are reasonably familiar with the movements of the solid crust of the world, which, however, in terms of the whole, is equivalent in thickness to an eggshell. The same is true of the primitive disposition of various continents and oceans, of which the final distribution is before our eyes. Cavendish, with his scales 'capable of weighing the world,' was able to determine the density of our globe by a simple laboratory experiment. The kernel, of more or less ferruginous composition and with a molten center, is surrounded by a spherical shell of lesser density and about seventy kilometers thick, of which the lower strata have a temperature of, perhaps, several thousand degrees.¹ The movements of the general magma and of the crust itself, under the action of solar and lunar tides as well as of seismic phenomena, constitute a vast scientific field which I shall merely mention in passing.

So much for a mere suggestion of the complexity of the world movements which have been recognized between Galileo's thunderbolt and calculations as to the weight of the world. Included therein are the problems of rotation and of translation — the latter at a rate of about 30 kilometers a second.² We must not omit mention of the relation of the world to the moon. The angle of the terrestrial axis to the ecliptic determines our seasons and the rotating irregularity of the length of our days and nights. The cycle of the so-called 'equinoctial precession,' which is affected by solar-lunar attraction, completes itself in twenty-six thou-

¹ It has been estimated that from one thousand to two thousand million years have elapsed since the formation of the world's solid crust. We are told that a trillion years have passed since our planet became detached from the solar nebula.

² The most powerful explosives do not impart to a projectile a velocity of more than one kilometer a second.

sand years. Since the axis of the globe is affected by certain oscillations the cause of which has been determined, we now know that the poles of the earth change position.

We cannot, it seems to me, ignore the general translational movement which is dragging the whole solar system through intersidereal space in the direction of Hercules at a speed of about twenty kilometers a second. Thus 'the terrestrial ellipse is transformed into an enormous elliptical spiral. It becomes a huge screw which has a maximum diameter (at the axis of the world) of 207 million kilometers. The thread of the screw, of which the earth completes one turn in a year, is over 627 million kilometers. It is also the measure of the sun's movement in a year.'¹

To sum up, the world in its entirety is influenced by eleven distinct and generally recognized movements which interlock and accomplish different results. To make the matter even more complicated, we must also reckon on the ocean tides and the tidal movements of the world's crust. Such is the basis of that 'anti-Galilean stability,' on which the Church openly staked its whole authority. The most absurd part of the whole matter is that, having lost the game, the Church still asserts an eternal and infallible power, as an offset to what it claims is the fallibility of science!

The fact is that our first empirical observations carried us far beyond the most extreme hypotheses of the greatest astronomers. Even to-day we have no right to assume that the great screw-thread of the sun is the final interastral reaction, and that beyond that any further reaction is a repetition. How can we even conceive that, wherever it may be, there is a limit to interastral reactions, which must mutually adjust themselves? The mere thought of such a possibility is most disturbing. One characteristic of our relative knowledge is our recognition of the fact that what we know does not go beyond a superficial appreciation of activities.

It is true that the atom, together with the various transformations of energy which bring us to the threshold of a

¹ A. Berget, *La Vie et la mort du globe*.

conception of a cosmic unity which has been distorted by the metaphysic of entities and by theological deifications, seems to promise something more. Unquestionably that is a great step in advance, but how can we determine its extent? We are trying to find the unity of matter and energy, but we cannot assume that we have found it in the activity of the electron. What is matter? What is energy? It is easy to draw a line between them, as far as mere words go. To date, all we can do is to recognize motion and its transmission, without being able to differentiate between the two.

Moreover, there are times when, without the aid of any determined theory, the atom discloses fixed analogies between the planetary cycles and the electronic cycles which might, if coördinated, supply the key to the universe. It is too soon to commit oneself to the intricacies of this new theory. Nevertheless, it is a strong temptation to try to find a final coördination in the world-cycles which now revolve in accordance with laws of which we know nothing. At the moment we can only say that, for the first time in the history of human knowledge, science can give us a general view of the universe as a whole which is something more than merely hypothetical. Later research will determine its value.

Does not a general conception of the world based on a study of phenomena move us more deeply than do the puerile fairy-tales of theology? The emotion we feel as the result of developing knowledge continues in spasms of an increased power of perception and tends toward a closer relationship between man and the world which produced him. Necessarily the quality of that emotion depends on a more or less accurate understanding of relationships. Dreams, at least momentarily, arouse enthusiasms far keener than those produced by slowly-developing hope under the control of cold facts. In spite of everything, increasing knowledge will continue to inspire, at least in superior minds, strong and fine feelings, which are the best things in life.

In our short span of life, should we not be satisfied with relative theories? Why should we concern ourselves with intersidereal reactions unless we hope to find in them links which connect man and the universe? No matter how completely imagination may have filled up the gap, henceforth we shall need a foundation of scientific fact on which to build that edifice of knowledge which must withstand the onslaught of dreams that, because they preceded science, pretend to be more or better than science. Increased knowledge has broadened the scope of the human mind. An orderly joy in knowing has taken the place of the dazzling thrills of imagining. That there should result an upheaval when hallucinations are relegated once again to the clouds is wholly immaterial. At school we are taught two contradictory theories of the Cosmos. Of these the Biblical one is fortified by rites and mystery and borrowed trappings, whereas the scientific one depends on certain firmly established facts on which to base positive conclusions. Revelation establishes a childishly simple personal relationship with the Almighty Master of the world and of ourselves, whereas the best that we can hope for from the arduous work of science is to stumble upon a few discoveries. As between the two alternatives, is it surprising that the ignorant masses make an immediate choice? However, that does not prove that humanity may not later change its mind.

At some time in the dim future when mental exercise shall have made our powers of knowing more flexible, we shall, perhaps, wonder what these exponents of the absolute knew about their subject. And, since we shall stand in the position of trembling cross-examiners of the Almighty, it may occur to us that it would be wise to ask a few questions before obeying his behests. The charm of the fairy-princess who lures the ingenuous knight into her enchanted bower vanishes at the crucial moment, and there remains only a bony hag, draped with tinsel finery, to offer her hideous embraces to a vanished love.

Progressive scientific knowledge promises less in the way

of tangible realities, but gives more. That is because, to the legitimate satisfaction which science gives, there will be added slow, but ever increasing, emotional joys caused by the appreciation of a marvelous world ever greater and more beautiful. That God who promised everything has given nothing, whereas science, at first so timid, has surpassed its wildest hopes and discovered coördinations of relationships, crowned with idealistic inductions which disclose for our delectation the glories of the world and of ourselves. Very likely these may be only subjective reactions, but what firmer starting-point could we find than to use ourselves as a basis within the limits of the recognized conditions in which we live? Moreover, no other starting-point is available.

At the point which we have now reached in our knowledge of evolution, can there be any question whether our theory of life should, or should not, harmonize with the unalterable laws of science? Is not an idealistic knowledge of what is preferable to the misleading will-o'-the-wisp of hallucination? Can we be satisfied to buzz at the window-pane, when the whole world stretches before us? Which shall we choose, progressive knowledge, forestalled here and again by hypotheses, or a mirage? In one case every engine of assault will be brought to bear upon the stronghold of ignorance; in the other, phantom battalions will march to the conquest of the puerile delights of a life which will pass before it has been lived.

Only the man who dares boldly to measure himself in terms of a relative knowledge of the inaccessible universe can rate his ability to think high enough to attack, with his eyes open, the problem of world-powers which he cannot grasp. Neither the mysticism of metaphysics nor that of theology will penetrate deeper into the absolute of this world — which, in the last analysis, is life — without the help of a human experience of universal interrelations, the field of which mental evolution will constantly enlarge, but which it will never exhaust. The limited knowledge with which we face the fortifications of a suggestive but reticent

world will produce greater results than our incipient understanding allows us to expect. Mother Earth, with her harmonies and her compelling laws, holds us tight to her bosom. Very wisely the new-born babe does not resist; behold how it has grown!

GEOLOGICAL AGES

Time and space have been universally prodigal of themselves in the cosmic cycle. In respect to the formations of the earth, we can risk comparisons of periods, founded on certain accepted facts. Estimated figures are very apt to confuse us in our appraisals of the remoter ages. Basing our conclusions on the disposition of rocks and on the relation which fossils bear to the ground in which they are found, we have been able to determine the stages of an orderly succession of phenomena, and we can thus speak of the approximate chronology of the sedimentary strata under the earliest oceans. Even so, how can we compute in terms of thousands of centuries the length of the various geological ages? 'These periods were of appalling length,' says Professor Boule, 'and must be calculated in figures similar to those used by astronomers in determining cosmic distances.'¹

It required long ages for sedimentary and volcanic rocks, in contact with the ocean, to produce the continents we know. The sea, succeeding fire, became master of the steaming globe. The ocean was thick with suspended and dissolved material. Its temperature was very high. As the result of precipitation, sedimentary strata accumulated on the ocean-bed; little by little they drove back the water, and through slow stages of development, ultimately formed plains, mountains, valleys, and dominating barriers of rock.

The cooled shell was still too thin to remain quiescent for long. As soon as the fragile crust broke, the burning mass

¹ *Les Hommes fossiles*. The formation of sedimentary deposits must have required between ninety and six hundred million years. Rutherford, using a different method of calculation, reached a figure of four hundred million years. According to Arrhenius, the condensation of the ocean occurred one hundred million years ago. These figures must be considered as mere approximations.

from below temporarily recovered the upper hand, until the ocean again subdued it. For long ages the contest continued between raging waters and explosive gases which hurled mountains about as if they were flecks of foam.¹

Behind the hurricane, in the depths of the sea, beyond the passing phenomena, lay life in its full power, waiting to be born. Time passed, much time. What do millions or billions of centuries matter when infinite time and space lie ahead?

Scientists are inclined to believe that the earliest manifestations of life occurred in the Archean structures, which antedated the primary.

Thus it may be that it took as long to form the fossil-bearing strata as it did to form all the strata subsequent to the primary structures.²

Incalculable time elapsed during which primitive organisms developed as their changing surroundings determined.

In course of time the submarine structures, upheaved, broken, displaced, now by the movement of the waters, now by the folding of the crust, now by eruptions of incandescent rocks, became exposed to the sun. Ephemeral continents developed; they were constantly being eroded, or suddenly enlarged by the violent action of the ocean; turn by turn they appeared and disappeared. In respect to the continents that as chance might dictate fell back again

¹ It is unnecessary to enter into a description and enumeration of the known geological structures, which differ according to their composition, their flora, and their fauna. I list them in the order of their antiquity, together with their principal subdivisions:

(1) Archean (gneiss and mica schist) and Primary (Cambrian, Silurian, Devonian, Carboniferous, Permian). Granite and porphyry are volcanic rocks of the Primary Age.

(2) Secondary (Triassic, Jurassic, Cretaceous). The Jurassic Age is divided into the Liassic and Oölitic.

(3) Tertiary (Eocene, Oligocene, Miocene, Pliocene).

(4) Quaternary. Older and younger alluvial structures in which man first appeared.

I set down these terms so that, when one of them appears in the text, the reader may refer to this list.

² It is estimated that seventy-five per cent of the total elapsed time of the geological ages was occupied by the primary periods; nineteen per cent by the secondary, and six per cent by the tertiary.

into the abyss or permanently established themselves, neither time nor lost effort had any importance. The age of major convulsions passed. The vents of volcanoes alone remain to remind us of them.

Above the Archean sediment, in which traces of man's life are found, lie the massive strata of the primary structures, to an average depth of about fifteen kilometers. When one stops to consider that the creation of these deposits was probably at a rate which would show no perceptible change in the course of a human life, just as we see no marked change in the erosions going on to-day from the action of streams, or in the deposits being built up by rains and winds, we obtain some faint idea of the incalculable ages required to accomplish these major changes.¹

Consider also that the first manifestation of life occurred as far back as the primary period. The indications are that this earliest form of life was intensely active, and that consequently its spreading over the world was due to its mass and to its numbers, long before the complex coördinations of powers permitted the new organisms to assume their proper places.

A physico-chemical explanation and study of the composition of rocks would be out of place here. The earliest volcanic agglomerations were devoid of any trace of life, whereas, on the other hand, we find evidence of the first appearance of living creatures in the deposits left by the warm waters. Primitive creatures, which had practically no substance, could leave no impressions in the rocks, although some traces are thought to have been found in the earliest, so-called Archean, strata. I intentionally omit any mention of the element of time, which is, nevertheless, the principal factor of all transformations. When we try to judge the duration of geological ages (and the same is true of astral distances) in terms of our puny imagination, we are obliged to juggle millions and even billions of centuries.

¹ Notice the thick layer of 'humus' which in a very few years accumulates on the top of the trunk of a pollarded tree, and which supports a parasitical vegetation in which the dog-rose figures prominently.

It is, therefore, wisest simply to exclude time from our study of these phenomena.

In the ages which followed the primary period came the wonders of the vast Carboniferous forests, without which our civilization of to-day could not exist. In these forests there was a whole world of life which, together with the contemporaneous flora and fauna of the secondary era, took its part in the innumerable catastrophes which befell the land and the ocean, and which created, destroyed, and recreated the complexion of changing continents, leaving no trace on the pages of history.

Consider the vague outlines which we have been able to trace of the geography of the primary and secondary periods, so unlike the geography of to-day, and marvel at the stupendous power and fairy-tale-like history of this tiny planet, lost in the universe along paths which led to the wonder of thinking man.¹

Not less than one hundred and fourteen distinct geological periods have come to be recognized, and each corresponds to an age characterized by fossils peculiar to it. In mentioning this fact we should be careful to remember that all these classifications of time and of formations are merely terms, and that they do not indicate sharply defined stages of evolution from one phenomenon to another.

The evolution of the world has been continuous; indeed, it is continuing before our eyes. We do not notice it, because the changes are so slow. These changes comprise the formation and the shifting of the oceans; the solidification of the earth's crust; its contractions; its folds, which temporarily create continents, mountains, and valleys. All go to make up a long history which, thanks to the stubborn persever-

¹ One chance discovery, among so many, has led some people to believe that the famous tradition of an 'Atlantis,' whereby Europe and North America were once joined, is to be found in the outlines of the history of the secondary age. Why should the memory of this continent which, with theatrical suddenness, sank into the depths of the ocean have survived? It is impossible that an Atlantis of the earliest ages should be the same as the one of which legend tells. Undoubtedly, catastrophes of this sort were very many. The Biblical story of the flood seems to be one of the last episodes in the birth-throes of our planet.

ance of scientists, can be pieced together. Our world is nothing but a thin crust, scarcely cool and still shaking from the heat of the central conflagration which from time to time still surprises us with its eruptions, and the temperature of which (1500°) only a few kilometers away — not over seventy — maintains everything in a state of fusion.

Between the central fire and the surface there are four layers arithmetically described according to the order in which they are superimposed. In the earliest stratifications, the first sediments contain traces of fossils, often very difficult to identify because of the plasticity of their forms and the modifications which the constant activity of the hot waters and the shock of erupting masses have brought about.

This is perhaps an appropriate place to mention Arrhenius' theory of 'panspermia.' This theory suggests that very small germs have been, and in fact still are, being driven through space from one world to another by radiation pressure. If such germs happen to meet (and it is not at all certain that they do), and if they happen to fall on a cool planet which contains sufficient water, salts and oxygen, and on which the temperature is sufficiently low to permit oxidization, which is the chemical phenomenon of life, Arrhenius suggests that there might be born therefrom organisms capable of evolution. But aside from the fact that the theory in no way modifies the problems of biology, we can to-day consider it as no more than an hypothesis as yet unsupported by scientific proof.

An atmosphere of carbonic dioxide and water-vapor formed a blanket about the world and long maintained a high temperature propitious to the intense vegetation of the so-called Carboniferous Age, in which cryptogams and gymnosperms, now dwarfed, attained prodigious proportions. There were in those days no flowers or deciduous trees. In the seas, however, animal life was beginning. The first organisms, such as corals, shells, and molluscs, marked the first stages of invertebrate life. The trilobites, which fall into this category, were sufficiently developed to

indicate a considerable evolution from the protozoa. Not until after the primary period did reptiles, amphibians and vertebrate fishes take the place of the armored fishes. There were still no mammals and no birds.

The atmosphere had undergone a decisive change. Huge quantities of carbonic acid had become stored up in the deposits of carboniferous vegetation, and oxygen, resulting from the decomposition of mineral sediments, was, little by little, attaining the proportion it holds to-day in our air.¹ That was the great reaction which permitted the variety of development of animal life. The earth's crust cooled and became solid and relatively stable. This brings us to the secondary era, with its different geological structures and wholly new paleontology.

Cryptogams no longer dominated the vegetable kingdom; they made way for the gymnosperms. Trilobites disappeared, and belemnites and ammonites appeared and multiplied enormously. Shore-lines became defined, while the crinoids, sponges and corals took possession of the ocean-bed, which was composed of an accumulation of the shells of foraminifers and of radiolaria.

Thus occurred the greatest step in the evolution of animal life. From then on, vertebrate animals reigned supreme. It was fully as important a landmark in evolutionary history as was the first appearance of the life-cell, and, although less emphasized, it was quite as clearly defined. As evolutionary transformations became more clear-cut, the lower forms of animal and vegetable life declined and disappeared during the secondary era. The vegetation in the forests more clearly resembled our own. In fact, some of our trees of to-day existed then. Animal and vegetable life attained a higher plane. There were flowers and butterflies; ants² and bees displayed a precocious organization of social life. A

¹ In this connection we are told that the formation of the calcareous rocks required thirty-four thousand times the amount of carbonic dioxide which is now in the air.

² We can see in museums ants quite similar to our ants of to-day which have been imprisoned in fossil amber for several million years. Amber belongs to the tertiary period.

form of mental life came into existence, which in course of time made way for a type of cerebral development that, via the anthropoid, led to *homo erectus*.

At that time reptiles, because of their number, strength and variety, occupied the dominating position now held by mammals. There were walking reptiles, and flying reptiles, and crawling reptiles. It was the age of the famous diplodocus, now on exhibition in museums, which was not less than twenty-five meters long. It was the age of monsters, in the front rank of which we must put the supremely powerful *tyrannosaurus rex* (American Museum of Natural History, New York), which, Osborn tells us, was, because of its agility, size, ferocity and strength, the most extraordinary killing machine which has ever existed. Such organisms could not survive, for they were so destructive that the supply of animal life needed for their nourishment became insufficient.

Thus we come to the earliest mammals. In them we find the beginnings of powerful organisms which developing in sensibility, ultimately attained a high order of mentality. Soft-scaled fishes definitely took the place of the armored varieties. Vertebrate organisms, which were to dominate the world, began to show that cogitative power which was later to assume such commanding proportions, by irresistible outbreaks of the violence and fury embodied in those colossal creatures which are the pride of our museums.

Less spectacular, but, generally, having a greater potential power, the first warm-blooded mammals and the first birds entered late upon the scene. They showed a progressive organic evolution of mind which the monsters had not evinced.

Throughout these transformations the geography of the oceans and of the continents was undergoing unceasing and vast modification. These I will pass over. We now come to the tertiary period, in which we find deciduous trees (of which many still grow in our forests). Monsters still existed, but much modified, and they in turn either disappeared or adapted themselves to changed conditions.

There were mastodons, elephants, hippopotami, rhinoceroses, cave-bears, giant elk, hipparions, ruminants, carnivores, etc. There were monkeys. Perhaps there were men.¹

The quaternary strata, which overlie all the others, and which are covered by vegetable-bearing soil, are chiefly alluvial in character. The mammoth, the great cave-bear, and the reindeer were the monarchs of those days. The extensive growth of glaciers caused certain migrations. Caves, which were the result of aqueous infiltration, served as shelters for lions, for bears, for hyenas and even for man, when man appeared. Trickling water deposited in these caves clay, sand, pebbles, chalky substances, and remains of bones, and it is in such deposits that we find the authentic evidences of the earliest humanity.

The surface of the world became more stable, and human remains now bear witness to organic evolutions, the order of which, however, we often cannot determine. We discover fragile remnants of sketches, miraculously preserved from the chemical and physical reactions which took place throughout ages of upheaval; we find implements made of chipped or hewn flint. Such was the Paleolithic Age, followed by the Neolithic Age (age of polished stone), after which metals supplied man with new means of progress. This era was followed by what we may term actual history, namely, the sequence of events which in course of time the light of knowledge may outline against the blackness of night.²

¹ From time to time people have discovered, or thought they had discovered, stone implements, either chipped or even cut, in the strata of the tertiary period. But eoliths, to which the action of water has given an analogous appearance, indicate how difficult it is to distinguish with any degree of certainty. In any event, no traces of fossils of man have as yet been found in the tertiary deposits. This might be explained by the wear and tear of such a very long period.

² Much has been written about the age of the earth. It has been said that at least one hundred million years were required to account for the saltiness of the ocean, by the salt washed down by rivers. Personally, I should put the figure even higher. If one calculates on a basis of sedimentary strata, the figure will be between one hundred million and a billion years. It is useless to quibble when it comes to time or space. In 1886 R——, a professor of history at the *École*

The thickness of the various strata, which indicate the length of the period that created them, proves how unequal was the distribution of the time required to bring us to our present era. Compared with the Archean sediments, the thickness of which is substantially the same as that of all the fossiliferous strata, the primary period was very much longer. The quaternary age was relatively the shortest. As one approaches the surface, each period becomes shorter, yet organic evolution was more and more rapid. The contrast between the first and the last stratum of the quaternary age, the stratum in which man (perhaps dating from the tertiary) and his fossil bones and utensils appear, is very striking.¹

The fact that an art reaches a certain point of perfection does not imply perfection in other points at the same time. The cave-paintings date from the paleolithic age, which they do not appear to have survived.² The shape of certain tools seems to imply an æsthetic care as to material, and a happy sense of proportion by no means without merit.

Polytechnique, used as a textbook a volume which he himself had written and which began:

'3963 Date of the Creation of the World.
2292 Date of the Flood; etc.'

In terms of radio-activity we are obliged to put the figure at between fourteen and sixteen hundred million years. A study of the folds of the earth's crust would indicate two thousand million. So far, no one has exceeded this figure, which is large enough to give one a feeling of immeasurable duration. What a pity it is that Biblical 'Revelation' told us not a word of this marvelous history!

¹ It is estimated that perhaps ten thousand years have elapsed since the last period of the quaternary age. To-day, the changes in the world's surface, although very real, are to us imperceptible. How many years must we, then, assign to the quaternary age, which saw such vast alterations? Moreover, the thickness of the quaternary structure is almost negligible in comparison with that of the tertiary, with that of the secondary and, especially, with that of the primary period. What of the earlier deposits, termed Archean? How are we to estimate the length of that period?

² However, art, once acquired, in some manner managed to survive the partial or total catastrophe which overtook the most gifted tribes. It is evident that certain friable substances, to which were committed paintings and carvings, could not without exception have lasted. In the most modern phases of man's history, have not certain purely local developments come to an end, whereas the sum total of æsthetic progress goes on?

Pottery was not unknown. Some of the polished stone axes are veritable gems. We are told that the men of the paleolithic age were hunters and fishermen, whereas those of the neolithic age were agriculturists.¹ Unquestionably the characteristics of all these peoples were very mixed. From this period may date the dolmens, the menhirs, and the cromlechs. And so we come to the threshold of 'modern' times, and of the evolution of 'civilization.'

FOSSILS AND THEIR INTERRELATIONS

As a matter of fact, there are no such things as geological periods, successions of species, or evolutionary ages. They are classifications made by man to help him understand relationships. Thus, there is but one single phenomenon, of which we represent a passing moment, within which our sensations mark stages of the whole in order to classify, gauge, and think about them, and with which we must deal in terms of the whole if we are to see them objectively.

We name, number, describe, and analyze the stars, as we might blood corpuscles, which are to our bodies what, in a sense, the stars are to the Cosmos. The embarrassing thing is the identity of matter and energy, terms that isolate the positive data when they need to be synthetized if we are to understand them. Metaphysics gets around the difficulty by a method of personification, which theology carries one step farther by the attributes which it bestows upon Divinity. It is not much easier to shut ourselves up in the solar system, when the fact that the universe is coherent forces us to feel the repercussions of the infinite. This has not prevented us from cataloguing the remarkable mass of our scientific knowledge, independently of any conquest of the absolute, which runs into a list of words which have no connection with fact.

¹ I have seen, in the Malay Peninsula, not far from Singapore, a veritable marine city, crawling with life, which, superficially, cannot have been very different from the lake-dwellers' settlements of primitive times. The children, I was told, learned to swim before they could walk. In Europe, nothing remains of these earliest habitations, unless it be the foundation piles of which traces have survived in some lakes.

Describing the successive geological periods, with their respective flora and fauna, in the history of the world forces us to set up a progression of pictures, arranged serially, of which a subjective classification does not correspond to facts, because throughout all time the cosmic elements proceed in a fused and unbroken sequence. Thus we naturally fail to grasp the universal unity of the world's activities, which converge and diverge, cross each other in every direction, and reflect or interpenetrate each other, all at the same time.

Rocks, sedimentary deposits, fauna and flora are correlative existences the evolution of which is so interlocked that examples of the tertiary age, as compared to those of the quaternary age, cannot be understood without reference to the preceding ages. The carboniferous forests, which were nevertheless sharply defined, left, throughout the ages next following, obvious traces in the vegetation. It may well be that certain forms survive in a much modified form in our flora. The famous monsters of the periods of which they were the outstanding characteristic, wandered about the world for an indefinite time during the early part of those ages which, because of new climatic and other conditions, were to destroy them. We still have elephants, giraffes, rhinoceroses, hippopotami, and even men whose development is still backward. Instead of insisting, for purposes of analysis, on considering the world as divided into sections, sections which we ourselves invented, and which emphatically do not exist, should we not do better to try to consider it in terms of its simultaneous syntheses, and such as science has definitely proved it to be?

I do not even summarize the classifications of paleontology. Nevertheless, any one wishing to understand the organic relationships proved by the close similarity of existences, or the strict relation which characteristic organs of the individual bear to the whole, will find a knowledge of paleontological subdivisions essential to his study.

The regularity of cosmic activities — evolution — depends upon the interdependence between the individual and

the conditions in which he lives, through an exchange of influences, which continues until the next succeeding stage of energy is established. Atmosphere, water, sediments, vegetable or animal life, as they existed in each age, disclose the inevitable evolution from cellular protoplasm to thinking man. Regardless of how striking changing phenomena may be, this theory of universal continuity of action must be the foundation of all study. The idea of a capricious and omnipotent will producing results wholly incompatible with science must, scientifically speaking, be eliminated. The same remark applies when our relativity is extended to include a form of amalgamation with the absolute by the imaginary addition of an 'immortal principle' (soul) which is preposterously called upon to link up life which has had a time of non-existence with an 'eternal' life.

We now recognize the inter-relation of all phenomena of the inorganic world. However, undeveloped minds had such difficulty in accounting for the transition from the inorganic to the living world that the only way out was rather childishly to charge it to the whim of an omnipotent person. Our ancestors had to rely on chance for their explanations, since they could not have recourse to scientific proof. At the stage of imaginative interpretation which we have reached, our only problem to-day is to determine how the primitive conception can be reconciled with subsequent and duly proved facts.

What does paleontology with its fossils teach us, unless it be the exact bearing of the phenomena of life upon the cosmic activities in which their coördinations were developed? Instead of magic letters, which enthusiasm swiftly wrote on the pages of Scripture, we see an incalculable number of centuries producing an authenticated series of organisms, definitely evolved. It is through this series that the human phenomenon proceeds through the various stages of coördinated lives until it attains the state of the thinking man of to-day.¹

¹ It is, indeed, impossible to maintain that remnants of skeletons of various examples of succeeding species, which are very similar, are wholly unrelated to one another. A simple comparison provides conclusive evidence to the contrary.

A long period of mental training will be necessary before the masses accept this new aspect of the universe. Can any one question the fact that we have evidence, and a great deal of it, from countless clearly-related remains of types of life which have now disappeared, as well as of types which still exist? Petrified remains bear witness to the existence of innumerable series of living beings; and yet, as is conclusively proved by traces of universal proliferation and by an unlimited extension of the various and tumultuous forms of life, an incalculable number of series have been lost. Not to lose oneself in this apparently inextricable confusion requires a great power of methodical coördination as well as subtle and skillful investigation. Leonardo da Vinci, Bernard Palissy, Buffon, and Cuvier — founder of comparative anatomy and paleontology — stand out pre-eminently in the work of reconstruction. This is particularly true of Cuvier, until he lost his head over his showy but hollow victory over Geoffroy Saint-Hilaire, which was purely academic, since to Saint-Hilaire, together with Lamarck and Darwin, belongs the glory of having brought to light 'the harmonious process' of evolutionary adaptation,¹ of which Goethe had the first glimpses.

This theory classifies all beings according to the type of their organisms. For example, the vertebrates are divided according to uniformly defined conditions whereby each organ is connected with the others by the interdependence of their functions. Cuvier demonstrated that the most diverse forms may have the same constitutive elements, although variously disposed. In respect to skulls, backbones, and of other members, this is true in skeletons whether of fishes, of birds, or of mammals. Whether in reptile or in mammal, the hind leg has femur, tibia, fibula, tarsus, and metatarsus. This fact indicates, according to Cuvier, 'a correlation of parts whereby, if necessary, each individual species of creature may be recognized by any part of each member. Each organized being forms

¹ I intentionally discard the more usually accepted word 'plan,' which implies the perversion that consists in a preconceived scheme.

a *whole*, a unique and *closed*¹ system, whose parts mutually correspond and contribute to the whole through reciprocal functional activities. None of these parts can change unless the others change also, and, consequently, any one of them, taken individually, determines and classifies the others.' Cuvier then cites the organic correlations in a carnivorous animal, namely teeth, claws and intestines, with their respective muscular conformations and their resulting bone formations, whether offensive or defensive. In conclusion he states: 'The shape of the teeth determines the shape of the condyle, of the shoulder-bone and of the nails, just as one segment of a regular curve determines the curve of the remainder.'

It is not surprising that, because of its inflexibility, this formula has appeared inaccurate when applied to the infinite complexity of organic actions and reactions. 'Nevertheless,' says Professor Boule,² while commenting on it, 'Cuvier has accurately reconstructed a number of vertebrates, of which he had only some of the fossilized fragments.' Thus applied, paleontology has made it possible to follow the major phases of organic evolution by means of the characteristics of each stage as manifested by respective links and coördinations.³

Each geological structure has its characteristic fossils, which make it possible to determine the conditions under which the organisms lived, as well as those under which the deposits in which they are enclosed were made. As I have said, the primary period saw the greatest development of trilobitic crustaceans; the secondary period was that of ammonites in the invertebrate field, and of the reptiles in the vertebrate field; the tertiary period was the age of mammals, and the quaternary period that of upright man. Albert Gaudry has summed up in a few words the value of the scientific formulæ of paleontology, when he states that thereby 'natural history becomes history in the true sense of the word.'

¹ Evolution has demonstrated that this word must be discarded.

² Marcellin Boule, *Conférences de paléontologie*.

³ An observation that was subsequently verified.

How far back can we follow this genealogy? That is the secret of the Archean strata, of which the lowest layers do not show the conditions necessary to the birth or development of life, whereas the upper layers, named crystallophylic, contain carbon in the form of graphite, which conclusively proves that deposits of organic matter existed. That fossils are to be found in them is now admitted. As to the length of time it required to form the Archean strata, we can only state that, in view of their great thickness, it cannot have been less than that which was required to build up the sum total of all the so-called fossiliferous structures. That seems not too much time to bring about the first effects of such a creation.

A study of these organic developments, even though restricted to the major ones which occurred during the great periods, can result only in a sweeping confirmation of the theory of interconnections as above stated. Regardless of how far the inquiry be pushed, whether in matters of detail, or as a whole, one finds only interdependent correlations of all the activities both of the organism and of the environment.

The vegetation and the animal life of the earliest period (especially of the Cambrian) were of the most elementary character. Indeed, the animals were very close to being plants. There were infinite variations on the same theme, the elements of which were soon to reach the end of their course. Fishes and amphibious quadrupeds were the first examples of vertebrates, but how long this particular stage lasted, it is impossible to determine. The spinal column of reptiles and of the earliest batrachians consisted of a number of pieces which in time grew together. In the case of one of the protritons, of which we have an imprint made by its skeleton, a beginning of a spinal column of partially solidified bone is discernible. Reptiles existed only in elementary forms, and there were no warm-blooded animals.

To this group of activities was added the first development of secondary life. To understand this development, one must constantly keep in mind that these subjective

classifications exist only as a convenience to aid us in establishing the relationships which constitute the whole substance of our knowledge. Setting up equivalent series of cosmic phenomena adapted to our mental development, is a procedure which determines a scale of positive classifications which varies according to our power of understanding. A great many years ago some sixty geological structures were recognized. To-day, as I have said, we know of one hundred and fourteen. Solidification continued to take place through stages which, individually, were not defined. Of these I mention only the four major geological divisions; to these the Archean, which, in turn, we are now beginning to subdivide, has been added. The world is nothing but one huge phenomenon in process of evolution. Like Hop o' my Thumb we drop pebbles here and there to help us find the way.

Inasmuch as I limit my observations to the succession of forms which marked the transition from the primary to the secondary period, it is obvious that although we may notice many likenesses and differences, we overlook so many more that it is quite absurd to complain about this or that gap in the sequence. The important thing is to keep our sense of direction. One wonders whether we shall ever penetrate deeper into the mystery of the earliest forms of the cell and of the plasma. Perhaps we shall, but no one can foretell when or how. We have made a beginning of acquiring knowledge; we have not completed the task, and, what is more, we never shall. I feel obliged to begin this brief summary by describing the earliest organs which have been found in the upper layers of the Archean strata. From these I shall proceed step by step to the developments of the primary period, down to *Pithecanthropus* of Java, and the man of Chapelle-aux-Saints, who, indeed, is connected with Newton himself by a series of links, which in fact constitute the whole history of humanity.

Vegetable and animal life of the secondary period indicate an exuberant organic activity which took place in the vast setting of the primary period. Multiplication and gigantism

were immoderate. Evolution ran into blind alleys, the result of incongruous formations which by checking or developing organisms turned it into new directions. In the vegetable kingdom gymnosperms (bare seeds) became dominant. Two groups of molluscs — ammonites (of which over three thousand species have been identified), and belemnites — chiefly characterized the secondary period, just as the trilobites characterized the primary period. Among the vertebrates, which were to become the dominant type, we can see in the case of the huge reptiles how evolution proceeds by the extinction of organisms unsuited to conditions which have undergone a change.

The geography of the various continents and oceans has continued to alter. The temperature has fallen. The tropical life of to-day is a last surviving remnant of a flora and fauna which in primitive ages were widely distributed. Animal organisms, closely akin to plants, which in turn are not far removed from minerals, constitute a world that I shall not try to describe. I have in mind corals, polyps, sponges, protozoa, zoöphytes, echinoderms, molluscs, etc. Their attributes of defense, of attack, of assimilation, and of reproduction are infinite. Apparently, all possible formations were successively tried throughout the various stages of evolution. Of these formations the best survived, whereas the others disappeared, or are doomed to disappear.

Living crustaceans very similar to those of the secondary period have been found in the deepest parts of our oceans. Could there be a better proof of the unbroken chain of evolution? Insects were developing. Bees, ants, and butterflies appeared in the secondary period, simultaneously with the flowering plants without which they could not live. Bony fishes became vertebrates endowed with a complete bony structure. The dog-fish, the shark, and the skate have retained the cartilaginous skeleton. Teeth and fins of these species, found in the deposits of the secondary period, prove that they existed in that age. Boule tells the highly significant story of a peculiar tooth discovered in the Triassic strata. It was impossible to identify the animal to which it

had belonged until its counterpart was discovered in an Australian fish which breathed simultaneously through its gills and through its lungs. The living fish was identified by the remains of the extinct species.

The reptile world of the secondary period could fix our attention indefinitely. Undersized types have been found in the layers of the late primary period. To-day we find them either in mixed forms, or with peculiarly individualistic characteristics resembling those of mammals. They are conclusive indications of overlapping stages in evolution.

I shall not go into any extended consideration of large reptiles, either of the land or of the sea. The curious reader will find much information in Boule's small but lucid manual. Most people are familiar with the ichthyosaurus and the plesiosaurus of the Jurassic oceans. 'The ichthyosaurus,' writes Boule, 'had the body and the bones of a fish, the snout of a dolphin, the teeth of a crocodile, the head and breastbone of a lizard, and the feet of a cetacean. It was from one to ten meters long. The plesiosaurus also had the feet of a cetacean, but its head was very small, like that of a lizard, and its neck was long and snake-like. Some species were as much as fifteen meters long.' The mosasaurus (twenty meters in length) was a huge swimming lizard with formidable jaws. No one can deny that these provide conclusive evidence of organic interrelationships.

In view of such pertinent proofs I see no necessity of entering upon the fantastic domain of the huge land reptiles of which the diplodocus is an excellent example. So far, the brain had shown no sign of development. Portions of the skeleton resembled the skeletons of birds. It is claimed that the dinosaurs and the birds had 'ancestors in common' of which, some day, the remains may be found in structures of the primary period. Indeed, flying reptiles existed in the secondary period. These were the pterodactyls. In this category belongs the famous archeopteryx, which was half a bird with teeth and half a reptile. It is significant that certain characters which are clearly reptilian can be observed in the

embryos and in the young of various birds of to-day. The birds of the Cretaceous Age differed from those of the present, only because some of them still had the teeth of the *archeopteryx*. No matter what field one studies, the evidence of the continuity of the evolutionary chain is conclusive.

At the time when the reptile was dominant in the world, small, warm-blooded mammals began to appear. This was the beginning of a long history, which includes the history of ourselves.

With the advent of the tertiary period, ammonites, belemnites, and giant reptiles disappeared. Mammals dominated the world. The shape of the oceans and the conformation of the solid land, which emerged slowly, assumed an appearance similar to that of to-day. The temperature continued to fall, and various climatic changes occurred. The quaternary period, characterized by the first appearance of man, more and more closely resembled the modern period in which took place, and are still taking place, the latest evolutionary developments. The huge birds of Madagascar and of New Zealand did not disappear until the eighteenth century. By innumerable bone formations, evidenced by remains of skeletons, the mammals bring innumerable signs of those interrelationships which Albert Gaudry has brought out with such clearness.

Among the earliest specimens of mammals of the tertiary period there exist synthetic types which were the forerunners of those of the present day. I refer the reader to Boule, for a discussion of this matter would lead me too far from my subject. I will merely mention the *phenacodus*, which was an animal similar to a wolf, with teeth crowned with little knobs, and members that combined the characteristics of a carnivore, of a rhinoceros, and of a horse. We have a series of rhinoceros skulls the determining characters of which form a series according to their habitats from the skull of the hairy rhinoceros of the quaternary age in Siberia through the skulls of the Pliocene Age in France and in Italy, the upper Miocene Age in Greece and the

lower Miocene of Orléans, back to the Oligocene of Auvergne.

We must pause a moment to study the very remarkable evolution of the horse or soliped, which would, apparently, have first appeared in its final form, had its development been 'independent.' However, we have a series of examples, which indicate a successive development in the general mammal structures, very characteristic of the soliped. The remarkable specimens in the American Museum of Natural History in New York, together with those in various European Museums, show clearly 'how little, five-toed animals grew and developed into running, one-toed animals, and how their tooth-formations evolved from the omnivorous to the herbivorous type.'¹ The reader should note in Boule's 'Manual' the very remarkable series of solipeds, different types of which succeeded one another according to the geological eras, and which are highly characteristic of co-ordinated evolution. In the lower Eocene Age the animals in question had five toes; later they had four on the rear feet; in the lower Miocene Age they had three active toes, and one which had become a remnant. In the upper Miocene the middle toe was larger than the others, which no longer touched the ground. At last, in the Pliocene Age, the side toes became mere relics of the past. A similar evolution took place in the case of the teeth and of all the other units of the skeleton. American scientists claim that there are twelve stages in this evolution. As a matter of actual fact there were probably an incalculable number of these stages. Be that as it may, to-day we know the genealogy of the horse, or at least its outstanding features.

The same is true of the pachyderms and of the ruminants. In the case of the ruminants the leg is made of a single bone, as in the case of the horse, only in the former this bone consists of two pieces welded at both ends, although in the foetus the welding does not appear to have taken place. The successive developments of the legs are as clearly defined by the bone formations as they are in the case of the

¹ Boule, *Manuel de paléontologie*.

solipeds. It seems evident that the horse is descended from pachyderms which had an uneven number of toes, whereas the antelope and the deer are descended from pachyderms which had an even number. Similar exhibits prove that the evolution of the proboscideans is the same. It is unnecessary to push the inquiry further.

At various periods of the tertiary era the lemurs, or inferior monkeys, which had the tooth formation of pachyderms, first appeared. Later, in the Miocene Age, came the higher, or anthropoid apes, such as the chimpanzee, the orang-outang and the gorilla, which led up to still scarcely differentiated remains of pithecanthropes. Wise men are much in doubt whether the Javanese skull structure of the Pliocene Age should be classified among the anthropoids, or in some division of the genus homo. It is merely a question of terms. Having established the sequence of the evolution of animal life, it is a waste of time to linger over verbal distinctions and subdivisions which do not correspond to any known fact. The exceedingly low-browed skull of Pithecanthropus ranks in size between those of the great anthropoids and those of the earliest specimens of the human skulls dating from the quaternary period. Charts indicate that the skull of the Neanderthal man (now admitted to have been human) differed more from those of present-day men than did those of the chimpanzee from the skulls of the Javanese Pithecanthropus. Clearly that proves my argument.

Gaudry has written no less than three large volumes on the coördinations of animal life. This scientist's careful and extensive, as well as profound, investigations, aided by a remarkable acuity of mind, have permitted him to carry his analyses very far. The great value of this work lies less in its conclusions, which do not go beyond general scientifically established classifications,¹ than in its fertility in

¹ It almost seems that the author's chief concern had been to stand well with the highly prejudiced academic world, which so bitterly opposed the theory of the relationship of species, since from time to time he goes out of his way to refer to 'The Almighty Being' and to the 'Scheme of His Creation.' Naturally he does not stress this point.

ideas. Cuvier unfortunately ended his work with the theories of the 'revolutions occurring on the surface of the world,' and of the 'individual origins of species.' Nevertheless, he will always remain the gifted founder of comparative anatomy and of paleontology, because his able studies permitted him to establish the relations, that is, the differences and similarities, among related species. Cuvier's work put us on the road leading to the discovery of universal relationships, which soon followed, and 'thanks to which,' Gaudry declared, 'natural history becomes history in the true sense of the word, since it establishes the genealogical links among a vast number of beings, until then regarded as parentless waifs.'¹

One hundred and fourteen zones in the fossiliferous lands show 'an equal number of variations established in the animal kingdom.' But we are still far from being correct in our count. 'The former grand divisions of the geological epochs have given place to numerous small divisions, and if some day we should distinguish an infinite multitude of distinct layers, the line of separation would be still further blurred.' The most sharply defined of our geological and paleontological classifications would as a matter of fact be the result of our subjective analysis, while the inevitable overlapping would betray a generalized phenomenon of partitions which are no more than different aspects of continuing change.

The part played by the fauna throughout the changing geological conditions has still further complicated the problem, which fearless scientists are trying to solve. Gaudry, as he gets deeper into the study of the slow formation of geological structures and of the various subdivisions of their respective fauna, quickly comes to the conclusion that 'the age of man is very insignificant in the seas of time.' Of that there can be no question; but may it not imply certain consequences? To wit, that the age of life, in terms of the cosmos, may be nothing but an ephemeral accident, barely discernible in the whole?

¹ Albert Gaudry, *Les Enchaînements du monde animal*.

It is useless for me to proceed further into the limitless field of paleontological interrelations. Whoever wishes may study the matter under the able guidance of Gaudry whose general thesis is that 'In each period certain forms of life have appeared which distinguish it from the foregoing period; certain forms of life have disappeared which distinguish it from the following period; certain species have continued to exist which form the connecting links between the earliest and the more recent ages. Throughout, the creative, or *modifying*¹ power, seems to have been uninterruptedly active.' We now enter upon a consideration of the component 'granules' of the vitellus and of the sarcode, which take us to the very depths of all organized life.

In summing up his very able life-work Gaudry does not hesitate to conclude: 'Although I am convinced that animals of different genera are related, I am also convinced that relationships exist between animals of different *orders*. Ruminants and solipeds take the place of pachyderms, which are so similar to them that it is quite impossible to draw the line which divides the pachyderms from the ruminants or from the solipeds. . . . It is most interesting to discover relationships between species which we had considered as isolated units. . . . The evolution of different animals has by no means been equal. Thus, side by side with ruminants, such as gazelles, which have undergone the greatest development, we find other ruminants which have changed but little from their ancestral pachyderms.'

It seems futile to discuss the question of subjectivity or objectivity as expressed by our classifications into genera, species, families, orders and classes. All interdependence of organs implies an equivalent interdependence of functions, and every form of life necessarily evolves in conformity with the laws and conditions which govern the evolution of its congeners. Our interpretive classifications, whether of coördinated differences or of similarities, are merely markers along the scale which helps us to understand the progress of evolution. This is proved by the constant changes in classi-

¹ The italics are mine.

fications which result from new discoveries. Is not the same perhaps true of the inorganic world? What has become of the many classifications which to-day have been forgotten?

It has been conclusively established that 'the animals of every age are linked to those of the previous one by forms in process of evolution. Close connections exist not only among species of the same genus, but among genera of the same family, among families of the same order, among orders of the same class, among classes of the same phylum. . . . These relationships are quite as evident among the higher groups of organizations of various types.'¹

Thus we learn that the changes which have occurred in the animate world, and which are necessarily countless, were successively accomplished by a vast number of slight breaks in the apparent continuity. Whereas we know of one hundred kinds of oysters, now extant, we also know of over six hundred kinds of fossil oysters. Whole orders, even whole classes, have suddenly been discovered. Zoölogical groups are constantly increasing in number, and yet the explored portion of the sedimentary structures is insignificant in comparison with the unexplored portions. Ammonite molluscs are good examples of the mixed traits which characterize molluscs that are akin to each other. The same is true of vertebrates. Among fishes, the sharks, the ganoids, and the bone-framed fishes have unmistakably distinctive characters. *Such was not the case in past ages.* In those days the earliest sharks and ganoids had common traits which, in the secondary period, make it difficult to distinguish between them. The same thing was true of the reptiles and the batrachians, and of the reptiles and the birds. In certain animals of the Triassic Period one may clearly discern the transition from reptiles to mammals. The field of these changes will never be fully explored. 'The history of the solipeds, ruminants, and proboscidiens,' says Boule, 'shows that, by means of a series of intermediate forms, very fine present-day animals are descended from remote ancestors,

¹ Albert Gaudry.

which were small, insignificant, and but little differentiated.'

These changes, which cannot have been the result of chance, since we do not admit that chance plays any part in the development of phenomena, indicate continuous and coherent transition. That is what we term the law of evolution, namely, the sequence of succeeding differences, governed by the law of least resistance. It is the law which states that organisms become transformed in order to adapt themselves to changing surroundings.

This progress is a hierarchy of organic adaptations. Means of prehension, of locomotion, and of acquiring the necessities of life developed according to the conditions and became constantly more diverse. Similarly, the evolution of our sensibility creates increasingly acute sensorial reactions and the mental associations that are their inevitable result. The world, we say, grows in subjective beauty — an interpretation of cosmic harmony, to the passing phases of which our emotional nature responds. The progressive steps in the evolution of our knowledge might some day be considered as a paleontology of the intelligence. It will be merely a matter of time; unfortunately the time necessary to achieve this result may not be allotted us.

As a first step, let us make a note of the fact that as far back as the tertiary age, a vague and primitive state of mentality existed. The skull of the stupid dinosaur of that time shows that at the base the encephalus was less fully developed than was the marrow of the spinal column. Indeed, the present-day living world represents nothing but an infrangible succession of transitional stages from the fossil world, of which we are the continuing manifestation. All these divers worlds are, in fact, only one, 'like the divers ages of the same person.'¹ But in the case of the world these ages stretch back to the remotest geological eras 'in which life had not yet occurred, and in which the course of logical change in the inorganic world was preparing the way for the advent of the living world.'

The time has come when we must recognize that there are

¹ Albert Gaudry.

not two distinct laws, one applicable to the inorganic world, and the other to the organic world, but that they are merely simple subjective classifications of cosmic manifestations, in successive stages of sensorial evolution. We discover the world by the application of scientific principles, and we cannot do otherwise than take our place in it, as we see it, in accordance with the most clearly defined laws of paleontology. This knowledge of the world consists of relationships and, as we have seen, of progressive relationships. From now on we may rest assured that these relationships are part of an unbroken and unbreakable chain from which we ignorantly and foolishly tried to dissociate ourselves by having recourse to a verbal metaphysics on which we relied, pending the advent of science.

PALEONTOLOGICAL PICTURES — THE 'MIRACLE'

No spectacle is more deeply stirring than that of the animate world throughout the geological eras. Marvelous in its diversity, a bewildering array of prolific flora and fauna passes by us on its way to overflow land and sea with exuberant life, battling the angry elements. Tropical vegetation still gives us a mild picture of these early ages. Yet what is our tropical vegetation in comparison with the forests of the Carboniferous period? The elephant, the rhinoceros, the tapir, the camel, the giraffe, the hippopotamus, the whale, are a few of the surviving relics of an age teeming with animal life. And yet what are these when compared with those huge monsters, such as the dinosaur, the diplodocus, etc., that were supreme in a world which groaned under their overwhelming weight? Even these are not so impressive as are those unexpected beasts, such as the archæopteryx, the ichthyosaurus, the plesiosaurus and the mosasaurus, products of unrelated organisms, which so clearly prove the divergent lines of transition. It was a mute world the mere presence of which was enough to raise every question in anticipation of the day when the posterity of timid *Pithecanthropus* should be brought by evolution to the point of giving the scientific answer.

For in all the analogies, in all the coördinations of differentiated organs there was bound to be a significance that required systematized explanation, and it was the sensitive organism, the so-called human consciousness, which through patient study was to allow the utilization of these 'documents' of fossil archeology. Since by great good fortune these archives of a prodigious history have been preserved for our inspection, we cannot, without admitting a permanent deterioration, fail to examine these 'bones of the earth,' which are, indeed, far more inspiring than those which stirred Virgil's plowman to wonder. They will make it possible for us to reconstruct the marvelous record of the life of yesterday and to put it into gear with the life of to-day, thus making ready for the life of to-morrow.

Throughout past centuries we have trodden indifferently upon these deposits, so rich in remains of a vanished world. We have fixed our eyes upon the illusion of a blue firmament, while the key to the mystery of the world and of ourselves lay beneath our feet. We paid no attention to the testimony of actual remains that spoke loudly of extinct lives, and we disregarded the mud in which the beasts had left their mark as they went their ways.¹ To-day we delight in the prints of human ischia and of human heels left in the mud or the floor of some cave, from which we can visualize our remote ancestors, sitting on the ground and discussing some magical empiricism. Their stone implements, their paintings and their carvings are here before us. People had seen them before, but people preferred to look without seeing, without understanding. For them it was enough to dream, that is, to create the world as best they liked, rather than to study objectively what it had been, and what it is. How much easier it was to explain fossils as 'pranks of nature,' to ridicule Boucher de Perthes with his axes of flint, and to revel in metaphysics!

Men of the old world had, nevertheless, had a presentiment of the forthcoming testimony. Boule cites this passage which Ovid attributes to Pythagoras, and which is exactly

¹ The flowers, and even drops of rain left their imprint.

in point: 'Nothing dies in this vast universe, but everything changes form. . . . Nothing retains the same appearance for long. . . . What was once solid ground is now an ocean. Land has risen from the sea, and shells have been found far from the water.' The silence of the masses more effectively condemned these 'bold' theories than did the stakes and pyres of the Church. Two thousand years had to elapse before Leonardo da Vinci and Bernard Palissy upset the established prohibitions with brilliant ideas, which Voltaire's cynicism emphasized, for he suggested that the sea-shells found on mountain tops had been left there when pilgrims shook their cloaks, traditionally decorated with the insignia of cockles. Is not this typical of man's constant need of knowing, yet of how stubbornly imagination opposes knowledge?

Finally Cuvier made the announcement so long awaited. Taking what Geoffroy Saint-Hilaire had said about the unity of organic characteristics, and the fact that they might indicate some sort of typical scheme in the evolution of similar groups, he pointed out that all skeletons, whether of fishes, reptiles, birds or mammals, were made up of a skull and a back-bone, together with various other parts. He further stated that each of these parts was invariably made up, in turn, of analogous parts, obviously interdependent. Thus, the leg of any reptile or of any mammal always consists of one principal bone (the femur), of two lesser ones (the tibia and the fibula), the tarsus, the metatarsus, and the toes. This rather bold idea was predicated upon the theory that there was a 'correlation of parts whereby each species of animal could be identified by any fragment of any of its parts.'

'If the intestines of any animal are intended to digest only meat, and only freshly killed meat, the jaws must necessarily be adapted to devour a prey, the claws to seize and tear it, the teeth to cut it to pieces, and the locomotive system to pursue and reach it, the sensorial organs to detect its presence from a distance, etc. . . . The shape of a tooth determines the shape of the condyle, of the shoulder-bone

and of the claws, just as any segment determines the whole of any regular curve. . . . Whenever one has merely the tip of a bone in a good state of preservation, one can, by comparison, as effectively and positively identify all the characteristics of the animal as one could from the entire body.'¹ It was immaterial that Cuvier stated the law of relationships in teleological terms. It was essential to recognize the interrelation between the form of the organs and their functions before one could make a scientific synthesis thereof.

I have already stated that each structure contains fossils characteristic of it, from which it is possible to determine the conditions under which they were deposited. Thus we can, so to speak, watch the earliest plants and animals, from the cryptogams and the protozoa in countless multitudes, down to man, successively spread over and take possession of our world. Certainly that was an event somewhat more vast and rather more significant and inspiring than the lifeless history of war-waging conquerors, or than the magic-lantern picture of the traditional 'creation'! Since the length of the geological periods decreases progressively as one approaches the surface of the earth, and since the thickness of the Archean strata is fully as great as the total of all the fossiliferous strata, there must necessarily have elapsed between the depositing of the first sediments and the beginning of the primary age, a period of time fully as great as that between the primary age and our own. I have already called attention to the fact that the earliest manifestations of life were not restricted to the period of the oldest layers of the primary strata. The lack of similarity among primitive forms, eruptions, contractions, and upheavals of the earth's surface was not conducive to the undisturbed development of fossils. It is none the less a fact that layers containing carbon and even traces of protozoa have been discovered in the strata of the Archean period.

No matter at what moment a living organism may have made its appearance under conditions that still escape us,

¹ This statement by Cuvier seems to me so conclusive that I do not hesitate to quote it a second time.

ought we to feel that there is any greater 'leap' from a crystalline plasma to the organic plasma which produces the cell than there is from the chemical mother-liquor to the full-formed crystal? In the first place, there is no such thing as a leap¹ in nature, notwithstanding the *quantum* theory, for the *quanta* are completely interrelated in the common distribution of energy. We know only of interrelationships of transformation. When once we have ascertained the unbroken chain of evolution from the protozoan to thinking man, we need not, in the interest of biological metaphysics, quibble over the transition from the mineral plasma to the organic plasma which is the creator of all organized forms of life. Crystals also are part of an organized scheme; they undergo a process of regeneration as do life-cells. Indeed, strictly speaking, a crystal is an individual no more or less wonderful than the cell.

Since we nowhere find anything except an irrepressible flow of related phenomena, why should we especially exclaim over a particular transition the chief difficulty of which arises from the backwardness of our means of knowledge?

From the most elementary evolution down, what is, and what is not, a 'miracle' depends directly upon the state of our knowledge. Science consists of nothing but 'miracles,' in which cause and effect are merged.

To sum up. The major difference between the theological and the scientific explanation of the world lies in the fact that science is in full accord with all the manifestations of phenomena, whereas the imaginative explanation is constantly contradicted by obvious and proved facts. In such a case there is no room for the 'supernatural.' The word is meaningless when applied to scientific matters.

As an explanation of the origin of life, an apparently positive metaphysics coined a highly inappropriate term,

¹ The obvious difference between father, mother, and child does not prevent the child from evolving in terms of its parents from the moment when the ovum, which gives it birth, is fertilized. Mutations are merely the resultant of all evolutionary influences.

namely, 'spontaneous generation.' Since the world is governed by the law of causation, the generation of the plasma of a cell enveloped in a membrane through which are effected all the interchanges of assimilation, can be no more 'spontaneous' than is the birth of a crystal, which cannot take place apart from the anterior phenomenon that determines it. Oceans of the primary age mechanically deposited sediments, in which chemical affinities acted. Biological affinities, in their turn, functioned under conditions thus created. Hence we see that the whole sequence of biology and of chemistry is so interwoven that no one part can be separated from the others.

Exhaustive studies of the matter have brought us to the conclusion that the distinction between the 'inorganic state' and the 'organic state' is purely subjective. Until recently, certain properties were considered as peculiar to living matter. As is well known, the cell can extract from the surrounding medium the elements necessary to its nutrition and perform with them syntheses that are the despair of our laboratories. There is nothing analogous in the inorganic realm, for in order to grow the crystal must find directly in the mother-liquor the substance of which it consists. The transition between the two phenomena deserves study. The development of the cell-membrane can be demonstrated by a scientific experiment which consists in placing a small crystal of some metallic salt in a solution of silicate of soda. It soon becomes covered with a film of semi-permeable metallic silicate, which, because of the phenomena of osmosis, grows, buds and heals its wounds. This shows that inorganic matter can manifest certain qualities which appear peculiar to organic matter. Many other similar experiments might be mentioned.

It was the entitative term 'life' which excited in our minds the imaginative phenomenon of purely subjective names intended to define organic existence. Metaphysics, which never loses the chance to create entities, offers its 'vital principle' and its 'divine principle' to explain the whole problem. That amounts to an arbitrary sub-

stitution of the word 'supernatural' — which is in itself an admission of ignorance — for the actual state of things. We are told that there must be a 'god,' since certain evolutionary phenomena involve the use of the word 'life,' otherwise inexplicable. And we shall remain content with mere words until science establishes the facts.

To try to discover the origin of life in the earliest phenomena of evolution was regarded as little less than a crime. Without losing too much prestige, the Church has been able to reverse its position in regard to the earth's rotation. On the other hand, to give up the idea of the secret of the origin of life would be, for it, nothing short of signing God's abdication. The fact that Descartes kept secret, and later modified, those parts of his work in which he sided with Copernicus is an excellent example of the effects of that sinister state of mind which tried to retard and give a false direction to the progress of knowledge. Is it not a fact that even Pascal secretly rewrote a passage which smacked overmuch of the doctrines of Copernicus?

Now that we are no longer threatened with such terrors, we can quickly and resolutely devote ourselves to scientific research. But does our atavistic twist dispose us to accept at once the explanations of science? It is only natural that our hereditary tendency should prefer verbal classifications to the theory of the perpetual continuity of phenomena, especially as the former are necessary to a conception of the sequence of relationships, even though they may be a survival of those metaphysical entities which obstruct the path toward scientific syntheses.

The great danger of analysis is that our minds tend in a wrong direction, and we, therefore, dissect and subdivide, only to find ourselves obliged to rebuild. When we attempt syntheses, we have at hand only dissociated fragments of cosmic relationships which are apt to fit together by reason of what Cuvier terms 'special creations.' Most people who are willing to go beyond the crudest 'miracles' of the cosmogonies dare not deny the 'miracles' of life, which make possible metaphysical explanations.

There is no reason for not subdividing the 'miracle' of creation into a continuous chain of 'sub-miracles.' Most of our contemporaries take good care not to scrutinize too closely their own ideas as to the 'miracles' of every-day occurrence. An element of doubt, allowed to grow stronger, would not be far from an incipient admission. Indeed, the 'miracles' which take place currently, and which are the result of an ancestral psychic state, are numerous. Of them Pascal's Holy Thorn and the baths at Lourdes are excellent examples. Consider whether it is the 'miracle' that performs the miraculous cure, or the miraculous cure which unwittingly makes the 'miracle.' Be that as it may, the fact remains that many people still regard a 'miracle' as being of equal value with scientifically demonstrated facts, without troubling, naturally, to prove the matter.' A strong desire so to believe is, of course, a *sine qua non*. Of such desire there is no lack.

A 'miracle' is nothing less than a reversal of the laws of the universe and is supposed to prove the intervention of that Almighty who, it is claimed, made the laws. Apparently this is the theory which underlies the miracle of Buddha and of Christ walking on the water. In the ruins of Sanchi in India, which are of Buddhist origin, there is a bas-relief of a stair-case floating on the ocean. It is intended to depict the miracle, for in that country it is not permissible to picture the divine savior. The bas-relief tries to convey the idea that the same omnipotence which created a given order can, to surprise us, instantaneously reverse it. The establishment of the original order of things was a 'miracle,' and any departure therefrom is no less miraculous.

Do you not realize how much you depreciate your Divinity, which, by its very nature, is undefinable, by reducing it to the level of mutable man? You maintain that you can produce a Supreme Providence, yet, as you can conceive thereof only anthropomorphically, you cannot do more than create your Divinity in terms of your own inadequacy. Must

¹ For 'miracles' pretend to depend on observation, although their object is to proclaim its 'bankruptcy.'

you be told that in divinity there can be but a single and unchanging law, since any change would imply a lack of foresight? Naturally you change, because your foresight is not sufficient to anticipate all contingencies. He, God, who sees, foresees, and wills all things at once, cannot, without being inconsistent, change what he himself has created. Is not that the very reason why you want me to admire a world-order which meets all needs? If it is the Creator himself who bethinks him of supplementary changes to accord with human requirements, the world-order is no longer all-sufficient. A most embarrassing state of affairs!

On the other hand, the whole matter can be easily cleared up if the question merely relates to a residuum of the oldest conceptions of a primitive man creating a god in harmony with human conditions and leaving us an inheritance of inadequate notions that we blindly accepted. Thus it happened that the 'complete miracle' of the creation of the world as Moses tells it required, according to Cuvier, a complement of sub-miracles, to provide for the *separate* creation of the different species. Thus, when necessary, the Almighty had to be called in to account for subsequent discoveries which could not be explained by the theory of lump creation.

Most people will tell you that nothing can be more distinctly different from each other than inorganic matter and living substance. We must go beyond mere appearance. Is it by any means certain that there is a greater difference between the crystalline protoplasm and the amoeba than between the microbe and the human organism? Undoubtedly the microbe and the human organism are both endowed with 'life,' as was also Pasteur himself, but is the transition from one to the other any more of a miracle than that from the sedimentary complex to the organic protoplasm? The idea of a single creation once conceived must be followed out. But why stop short at the phenomenon of life, as though crystals, micelles, and cells did not provide identical evidence of belonging to the same synergies?

Astronomy, geology, and biology are parts of a coherent sum-total of phenomena, which constantly and everywhere indicate an unbroken sequence of transformations. Men of average mentality are hostile to the theory of evolution, simply because their childish vanity is more flattered by the idea that they are descended from a god rather than from the Javanese Pithecanthropus. It is another example of our insistence upon fitting the world to our fancies. Shall we never see the end of such puerilities? There is only one way whereby we can understand our world and ourselves, and that is to investigate and study it.

Silently, scientists are working at the great task. They are producing theories of the world's activities, in comparison with which oriental fairy-tales pale into insignificance. For who, without romancing, can describe the spectacle of events, yet fail to raise his impressions of the world and of ourselves to that pinnacle of emotion which the marvels of the universe are proper to inspire? The supreme achievement of man is to prove himself worthy of contemplating omnipotence, that is, the omnipotence revealed by Science, finally realized in the infinity of the cosmic elements which are masters of time and of space, by cycle evolutions, the future of which our imagination is incapable of grasping. And to crown all there is the evolution of consciousness which, ever rising in the scale of sensibility, subordinates the boundless universe with its whirlwinds of fire to the ineffable drama of a transient knowledge of the world — a knowledge sprung from the emotional nature of man.

TO FEEL AND TO ACT IN RELATIONS CONSTITUTE ALL LIFE

The question what life is remains unsolved. It is a tremendous problem, in the attempted solution of which the ablest minds have exhausted themselves, because they attacked it by trying to find so-called 'explanations' in inexplicable entities. Does not seeking to explain life by 'vital principle' or by 'vital urge' amount merely to saying, 'life is life'? If one multiplies the mental phenome-

non by the infinite number of our powers of abstraction, the result will be, before science deals it a death-blow, a hectic metaphysical world, which is nothing but the arbitrary substitution of a mass of bewildering symbols, having no connection with facts. What is the much-talked-of phenomenon of 'life in itself'? Who has ever seen, recognized, or identified it? How could any one have done so, since it is only a verbal expression of a generalization of the absolute, of which the only restriction is that it shall be unrestricted?

How can we help finding gaps in all parts of the interrelation of our subjective realities with the inconceivable infinite? First, we must grasp the tangible phenomenon. Next, we must coördinate our interpretations thereof. Can we expect to discover in some Archean sediment the casual imprint of cells or of plasmas? It has even been claimed that not only the shapes but even the movement of protozoa have been found in these deposits. It is well to remember that the sun which shone upon these changes is not the sun we know. Different activities produce different results. Pasteur maintains that the present solar conditions could not have produced the first life-cells. That does not mean that, in the matter of producing life-cells, we shall not be able at some future day to supply the deficiencies of our present sun, which succeeded earlier suns still represented in the heavens in the form of variously colored stars. The formation of the first crystal is neither more nor less 'miraculous' than that of the first life-cell in the overflowing proliferation.

The colloidal state, with its groups of micelles, which are collections of molecules, and with its 'mineral plasma,' so akin to the organic plasma which preceded the life-cell (which was to subdivide itself for purposes of fecundation), discloses forms of molecular life, just as the crystal indicates an 'inorganic' attempt to become an organism.¹

Since life is composed of actions of the senses followed by their corresponding reactions, how could sensibility have

¹ I will remind the reader that the interplay of molecular attractions and repulsions has produced forms of *liquid* crystals as well as what appear to be fragments of organic cells.

emanated from an insensitive world? Might there be an elemental state, which one could term 'insensitive,' although some other state was the only one which manifested reactions of sensibility? How can we pass from one to the other? Looking at things superficially, we at once notice reactions of sensibility occurring in bodies that have organs, whereas in the so-called inorganic substances we have as yet been unable to discover any such reactions. Is that sufficient reason for setting up an impenetrable barrier between phenomena unquestionably coördinated? Are we justified in basing our opinion on the mere fact that in one case we think that we discern an organic sensibility and in the other a universal insensibility?

There is no such thing, from the near-by atom to the remotest star, as a body 'indifferent' to its surroundings, that is, which does not react to actions which take place outside itself. The more you investigate, the more your observations will demonstrate that everything in the world is composed of series of energies, which cross, join, and react upon each other. Newton's universe consists entirely of stars, which are sensible to their mutual actions and reactions, and not one of which can escape from the effect of gravity. From our world to the farthest visible star, and even beyond, all world-energies are forever conflicting, interpenetrating, deviating or repeating themselves. No one has yet discovered a body 'insensible' to the phenomenology of diversely manifested universal energy. Were universal sensibility to cease, the world would end at the same moment. 'Indifference' is merely a verbal hypothesis with no scientific foundation. There can, therefore, be no grounds for substituting for this an imaginary void, a miraculous metaphysical sensibility, supposed to be exclusively the attribute of organic life.

We see in the universe only forms and reactions of sensibility, proportionate to the activities that cause them. A steel rod reacts electrically when I touch it. What further proof is necessary that it has its own reaction of sensitivity? What more conclusive evidence of a state of sensibility, in a

world said to be insensitive, can there be than the phenomenon of gravity? In that we perceive, in the full light of day, reactions of motion of incomparable violence, which occur in all the stars, whether visible or not, according to the cycles which express the most magnificent manifestations of eternal awareness. From the greatest to the smallest, the planetary cycles, which developed from the stellar cycles, demonstrate even more clearly that cosmic sensibility which produced them, and which is closely analogous to the activities of the electron. Likewise, it has been observed that inorganic complexes as well as organic ones are constantly evident in all forms of common energy. The cell is an individual, the composition of which is far more complex than that of the crystal. Nevertheless, the reactions of sensibility to which it is subject demonstrate a state of activity, because of the various elements which compose it. The same is true of the cell with its plasma.

In the case of the neuron the differences of characteristics are more defined and produce other complications. In the evolutionary sequence of the organic complex, the neuron (which is the sounding-board against which diffused sensibilities systematize themselves, to produce synthetic reactions), performs the function of a switchboard. Like the tuning-fork, its object is to register the relation between what is without and what is within, in order to reproduce the movement. Through the neuron, sensations of pleasure or of acute or dull pain are expressed by spasmodic vibrations of graduated frequency. Physical or mental sensibilities produce equivalent accords or discords between the world without and the organic surfaces of a particular, or a general, sensibility. The quality of the components bears witness to the state of equilibrium or disorder in the personality.

From the day we are born to the day we die the contacts between ourselves with our environment determine the course of our lives. During the period between the subdivision of the ovule and our birth, the world is reverberating in us through the effect of hereditary evolutions, the

complexity of which unfolds along guiding lines that can be traced. Can anything except science efficaciously determine the course of our lives? Words, which represent ideas, help us to express our sensations, even though sometimes they give false impressions. While powerful minds, working to learn more, try to set us on the right road, a horde of metaphysicians attempt to make us worship purely verbal entities, of which the outstanding characteristic is that our senses cannot detect them.

Offhand to endow our sensorial activities with the form of independent existences is to suggest an explanation which, first of all, should be explained. Next in the sequence comes the miracle of realized abstraction. Sooner or later the mask falls to the ground; the universe remains, and the entity vanishes. Instead of a verbal fiction, we find universal and permanent energy, the successive reactions of which make the world and man what they are.

The stars, the sun, this planet with its oceans, its abysses, its mountains, and its teeming life, are all aspects of the same event, that is, of the same sequence of phenomena, which react upon one another unceasingly, forming a chain which nowhere and at no time can be broken. Jahveh naïvely states: 'I am *he* who is.' 'I am *that* which is,' the Cosmos thunders in the darkness. What is the distinction between the two formulæ? Only an attribution of personality, which has never been scientifically proved to exist.

Why was it considered a crime to try to connect the phenomena of organized life with the universal inter-relation of cosmic phenomena? Scripture, in its anthropocentric ignorance, most absurdly tried to reduce the universe to the dimensions of a single planet in which two beings, without any standing in their own world, thoughtlessly determined what was to be the fate of their descendants. We are forced to recognize that there was a time when such rubbish was accepted. But when, from a flood of ignorance and mistakes, we had been able to salvage a certain amount of scientific facts such as those which I have briefly outlined, is it not sheer madness to insist on setting up myths,

based on the ignorance of ages, against the unshakable structures which science has built?

The fires about the stake have been extinguished, and, now that we have been released from the torture chamber, we can devote ourselves to the arduous tasks of scientific study. No longer are we hampered by the atavistic misconceptions of the past. The highly unæsthetic figure of the Javanese *Pithecanthropus* still tempers the eagerness of many to claim him as an ancestor. If one of our fine ladies were sitting in her boudoir with *Pithecanthropus* (latest model) and with the *man* of Chapelle-aux-Saints who is admittedly her ancestor, it is by no means certain which one of the two she would prefer. It is impossible to state in what way one of the earliest examples of humanity can be said to be superior to the more highly developed forms of the *pithecanthropes*.¹ Why should we arbitrarily refuse to admit that we are descended from an anthropoid ape which was becoming human, and yet humbly accept as an ancestor the Chapelle-aux-Saints biped who was fully as displeasing in appearance, and who probably could not express his sentiments or thoughts except through onomatopœic sounds.

As between two explanations of the phenomenon of life, why choose the 'miraculous,' that is, the one which denies all scientific sequence, whereas everything points to the continuity of evolution? How can one account for the secret appeal of an intellectual retrogression which, even to-day, leads people to look for the explanation of life in an interruption of the relations between phenomena instead of in the continuous coördination thereof?

Since man could not make the governing power of the world anything but a glorified human will, he made it in his own image; that is, subject to caprices and sudden whims. In the terms of his doctrine, he proclaims that his God is unchangeable and perfect, yet what he can show of that same God is so full of mistakes that his first act was to

¹ We have no choice but to admit that there were stages in the evolution of *Pithecanthropus* of which we are ignorant, but which, some day, we may be able to include in our classifications.

botch his work of creating the world through the failure of his creature, the model of which he himself chose. Is it not time to study the world instead of dreaming about it? We must rely on facts to understand it. We must determine the laws of things in order to adapt ourselves to them instead of childishly attempting to adapt the world to our own insignificance by supernatural intervention.

While the 'believer' spends his time complaining, in order to change cosmic laws for his particular benefit — which, should the prayers of each be granted, would produce chaos — the scientist beholds a world far more glorious than the wildest dream could create. Man no longer prays for miracles; he performs them.

The true 'miracle' of positivity is that the world is made up of waves which cross, overlap, and reflect each other to produce energy. Reflecting waves make the complexes of our sensibilities in a form of resonance called consciousness, which is knowledge; that is, the merger of what is without with what is within.

The world is composed of different forms of energy. Thus it is that physical energy, or chemical energy, or biological energy controls us. More than that, physics, chemistry, and biology are merely our own subjective classifications, the purpose of which is to keep within the reach of our inductive powers all the cosmic phenomena, which are inextricably confused.

We know little of the conditions which prevailed under the activity of a sun quite different from the sun of to-day, when the first organic complex followed the universal complex. The fundamental problem is one of an eternal flow, when one phenomenon followed another in an unbroken and unbreakable chain.

We call a phenomenon that moment of the Cosmos which, between two periods of unconsciousness, affects the corresponding moment of our sensibility. Unconsciousness is a failure to react; the phenomenon is the relation of our organic waves, passing into the ceaseless vibrations of the universe. In other words, we are aware of the field of the cos-

mic waves only through the repeated shocks of those waves on our receptive surfaces. Thus, a sequence of transient sensations gives us a sense of continuity, just as a long line of street-lamps gives us the impression of an unbroken line of light. Intervals of sensations, due to the periodic action of our sensory thresholds, produce the sensation of a series of shocks, which we seek to correlate. As far as we are concerned, this correlation is the supreme objectivity of the elements. I cannot help pointing out that this brings us back to the theory of the distribution of energy by *quanta*. And, pending new discoveries, that is the extreme limit of what we know of those activities, which are grouped under the heading of 'Energy-Matter.'

The theory of perpetual continuity as a suggested explanation of the universe comes into immediate conflict with space, for movement requires space. There must be a lack of continuity to permit the existence of relationships. The hypothetical ether, to which we attribute whatever degree of elasticity happens to suit our purposes of subjective knowledge, is said to be the solution of this problem. It may be that it does solve it.

I shall certainly be accused of using one particular word as the keystone of the cosmic structure as I have built it. Yet it is for doing exactly that same thing that I blame the metaphysicians. There is, however, a vast difference between an absolute formula upon which the universe is dogmatically asserted to depend, and of which no proof has ever been forthcoming, and the hypothesis of related activities, constantly made subject to scientific experimentation. If some one suggests a different hypothesis, we shall do our best to prove it right or wrong, but in any event we shall not burn alive the man who suggested it.

Irrespective of what we may discover in the future, we can, to-day, state that the difference between inorganic and organic sensibility is only one of degree. The injection of the word 'irritability' in no way changes the phenomenon. The determining factor is the successive and common phenomenology, which, both in the mineral and in the liv-

ing organism, takes place from the moment their respective forms of sensibility begin to function.

The first reaction to an organic sensation is a corresponding contraction and withdrawal. The actions and reactions of more or less different tissues will vary according to their surroundings. The osmotic changes which take place through the filtering action of the cellular membrane that differentiates the organ from its environment constitutes the phenomenon styled nutrition; that is, assimilation and disassimilation, which up to the moment of reproduction results in growth or in decrease. Although very diversified in form, methods of reproduction can always be reduced to the principle of growth by segmentation, which, in turn, means the hereditary transmission of continued nutrition.

Causation or evolution proceeds according to all the complexes of those elementary relationships whereby the crystal, as well as an anatomic organ, heal its wounds by developing into a predetermined form.¹ It is nothing more or less than the phenomenon of universal evolution, proceeding in a continuous chain, no link of which can be segregated from the ones which precede and follow it. The so-called gap between one phenomenon and another is not a gap. We are merely unable to perceive the transition. To the humble, but very worthy protozoan should be granted genealogical letters patent quite as authentic as our proud feudal titles. The 'supernatural' plays no greater part in the phenomenon of life than in any other stage of elementary evolution. To live is to keep in step with the laws of the Cosmos.

To live is to feel and to react to the phenomena of resonance which, like flashes of lightning, register the repercussions of the external waves on the innermost tablets of our organic beings. Before it is possible to determine the complexes of sensations which form a mental state it is necessary to start from the original causes of organic sensibility. The rest follows therefrom in direct sequence. Since words, to which an imaginary inflexibility has been attributed, can

¹ Might one not deduce that, since minerals thus evidence a form of cohesive motion, they may be embryonic 'organs'?

express nothing but the relationship of movement — which is all we seek to know — whoever wishes to get a clear picture of things as they are must first of all rid himself of that illusion of stability in which the apparent fixity of a vocal symbol, intended to define the eternal mobility, tends to hold us.

Words, which define the nature of the mental phenomenon, are apt to deceive us, and, in fact, do deceive us, at the same time that they enlighten, because they insufficiently define the relation between the symbol and the phenomenon which they symbolize. It is fortunate that, whereas our law impels us to leap in pursuit of elusive will-o'-the-wisps, that same law requires that we be capable of testing the soundness of the formulæ created by our imagination, which satisfy ignorant people, but which may lead them astray. The unrestrained flight of our verbal expressions is the first stage of an intellectual development, the progress of which must be subject to constant correction, as proof may determine. Many turn out to be magnificent structures, built from the roof down, with a complete disregard of any foundations on which to rest. The whole question depends on whether we shall work with our feet on solid rock, or whether we shall continue to build in the clouds.

Poincaré wonders what an ancient Greek would have thought had some one told him that the red ray vibrates four hundred million million times a second. He would have accused his informant of being insane. To-day, the dogmatic followers of Revelation do exactly the same thing when people talk to them of transformations and evolution. The latter are less excusable, since they cannot deny that the sun is distant from us some hundred and fifty million kilometers, and that the distances from the earth to the nearest stars are hundreds of thousands of times greater. Their stumbling-block is not so much the difficulty of understanding as their inability to reconcile the universal results of exact observation with the fallacies of the principles of their Revelation which, either from mental incapacity or for reasons of social interest, they are unwilling to renounce.

'The stars are crucibles gigantic beyond the dream of any chemist. Temperatures exist therein of which we cannot conceive. Matter is there to be seen in a thousand different states, from rarefied gases, which seem to form nebulae, illuminated by heaven knows what mysteriously begotten light, down to incandescent stars and to planets, so near, yet so unlike our own.'¹

This is the climax of the great drama of humanity, for man must choose between the absolutism of a superhuman Revelation, and the thankless task of human endeavor seeking for fragmentary and experimental knowledge of interrelated movements. The supporter of Revelation has a terrible advantage, since he offers what he cannot give, whereas the investigator cannot guarantee that for which he permits his followers to hope.

Are we to accept the 'evidence' of dogmatic formulæ, metaphysically supreme and reinforced by promises of eternal bliss and of eternal punishments? Our alternative is to rely on the unpleasant guidance of approximate truths, which will forever undergo revision. Can we find the acme of happiness in dedicating our best efforts to such a task? Without the slightest hesitation, I answer that we can.

With blatant confidence in imaginary glories, and without giving a thought to the distortion of the facts involved, the atavistically atrophied masses will continue in the mental attitude of past ages. They will remain under the guidance of self-seeking organizations, and they will allow speech to take the place of thought. In spite of such a state of affairs, how can such an attitude prevail against the irrefutable objectivity of science which, barring the complete collapse of human intelligence, must in the end emerge victorious from the conflict?

May it be granted us to acquire the courage necessary to attack the problem! To react and to feel in terms of rela-

¹ Henri Poincaré, *Valeur de la science*.

Auguste Comte, falling in with the tradition of the Church, tried to prohibit the study of the composition of the stars, on the ground that it was useless. He did not foresee the discovery of the spectroscope, which has made possible modern physics.

tivity is the life-essence of all the elements of the world, not excluding the phenomenon of knowledge. Imagination is prompt to over-shoot the mark, and science is slow to follow the right path. We are no longer in a position where a choice is possible. In exchange for the sterility of theology, scientific investigations have produced a prodigious coördination of proved facts, which decisively affect the scales. There remain only the supreme and inevitable transformations of emotivity which will follow step by step the developments of human intelligence.

CHAPTER XII

EVOLUTION

I

COSMIC CYCLES AND THEIR COMPONENTS

THE word 'evolution,' closely akin to the word 'development,' contains a metaphor so simple that it needs no explanation. It expresses the idea of a perpetual succession of connected transitions from one state into another. Do the activities of the Cosmos beget one another, or is each manifestation alien to the next?

Phenomena are successive, but whether they are independent or dependent is the problem that evolution should solve by emphasizing the strict coördination of the laws which inexorably bind them together. Would they not be meaningless if otherwise ordered? How can one conceive of a whole if the parts are not coördinated? In that case, the world could consist merely of units in juxtaposition, with no possible fixity of relation, since, without some general law, juxtaposition itself could not exist.

To go one step farther. Since phenomena consist of movements,¹ each movement, if unrelated, would have to be itself a beginning, that is, an effect without a cause,² and at the same time a final end, since no prolongation would be conceivable. In other words, each phenomenon would be pocketed between two moments of nothingness between which something would be created and disappear indefinitely. A flood of simultaneous creations and deaths amid infinite space and time would then replace Biblical creation. No laws of any kind would exist. There could be

¹ 'Between two bodies, each in motion, all movement, whether felt, increased, decreased or lost, depends on the ratio of mass to speed. Every variation is a type of uniformity; every change is a form of constancy.' (Montesquieu, *L'Esprit des lois*.)

² That is why some persons have said that 'evolution' is merely a formulation of the principle of causation.

no trace of generalization, since there could be no connection among the elements. There would be a Cosmos such as no one has ever been able to conceive — a discoördinate 'coördination.'

Divinities were created to establish order in chaos. But anthropomorphic divinities could govern only by their changeable volitions. This is proved by miracles and by endless prayer, the object of which was to influence their purposes. Order requires rules, and these rules we can find only in the cosmic laws, which express constant relations. In acknowledging them we simply recognize facts as they are.

And since to produce such a state of affairs, movements must be related in varying ways, an evolutionary order is the necessary consequence, for the movements succeed one another according to fixed rules of antecedence and consequence which engender and develop the world before our eyes. Generation, development, and evolution are plainly the appropriate terms because of their analogy to the course of the biological activities which in the successive phases of embryonic growth cause us to pass from the condition of a germ to that of the new-born infant. The interrelations could not be linked up except through the progressive changes, independently of which the world could not exist. Thus the 'doctrine' of evolution is reduced to the simple recognition of the fact of movement.¹

If everything is in transition, what is our planetary future to be? So far as we can conceive that future, it consists of cycles that are closed somewhere. In accordance with fixed laws, the developments of ordered energy that, so far as our observation can reach, constitute the characteristics of the Cosmos, are adjusted to astronomical cycles. Newton's discovery of universal gravitation enabled us, through the simplicity of the formulæ, to penetrate the inter-

¹ To produce an instructive exposition of evolution and of transformism, and for the related studies in natural history, I should have to write encyclopædias, for the younger generation of laboratory workers do not fear to attack the most arduous problems. I can do no more than refer the reader to the abundant publications of Jacques Loeb, Yves Delage, Le Dantec, and many others.

astral relations which seem to be the law of the endless universe even beyond the point at which the relativity of our organs compels us to stop. That is no mediocre achievement.

If the Church had been able to perpetuate Galileo's shameful recantation, our knowledge of cosmic activities would have been cut short, and ignorance would have maintained its monstrous dominion. Like the symbolic Titan, expiating on his rock his audacity in opening the path of human knowledge, we should have been forever fettered with the unbreakable chain of the 'divine.' Thus, the higher achievement of cosmic energy, the concentration of universal resonance, transiently manifested in the phenomena of human consciousness and of the ensuing knowledge, would have been omitted from among world phenomena, of which it is the greatest.

Indeed, we are confounded at the folly of such a possibility. Not China, or India, or Greece, or even any dogma of savages carried aberration to the point of wanting to confine the human mind in that ominous impasse. In spite of the vague verdicts against Anaxagoras and Socrates, the great peoples of history intended to clear those principal paths of our intelligence which led to the first faint light on the borders of the unknown. Remember the famous questions of the Veda. There we found the ingenuous audacity of a doubt following the spontaneous mythic and unscientific interpretation of the world. The extravagances of a mistaken philosophy in which words took the place of facts disfigured the face of the universe by substituting confused dreams for manifest realities.

What professional phrase-makers have not yet been able to understand is that such an enterprise as theirs, still kept up by the Congregation of the Index (an institution which, unsupported by the executioner, becomes ridiculous), cannot but go down in convulsive impotence while there remains in the world a single man to observe and to systematize, that is, to think within the measure of his capacity. Better still, were there not one such man, mental evolution,

which cannot be coerced, would sooner or later burst through the limits of universal lethargy and finally let in upon us the first light of intelligence. Fortunately, we do not need to await that day. At present the reactions of human intelligence are actively aligned against the most arrogant enterprises of stupidity. We have known the power and splendor of 'infallible' dogmas, the apparent masters of thought. To-day, we see those same dogmas disintegrate, carried away by a current of knowledge which no one can turn back. Ponder the imprescriptible succession of conquests that experimental investigation has won from the day of the man of Chapelle-aux-Saints and even from the day of Newton!

I note the fact and pass on. At present, no more than average culture gives a sufficiently comprehensive view of cosmic activities which are recognized as verified. Our age-long effort can bequeath to the future nothing but topics of thought somewhat supplemented by scientifically coördinated generalities.

However, let us in our turn beware of the dazzling temptations of an advance toward a scientific absolute, if I may be allowed to join two necessarily contradictory terms. The relations that we establish can express no more than a moment of things — a schematic point at which ceaseless activities meet. Far from being able to rely, for example, on any constancy in weight, we find that for known reasons it varies at different points on the surface of the planet. We know, for instance, that any body falling at any specified point causes a general repercussion in the distribution of gravitational energy. If the contraction brought about by cooling leads to a diminution of the terrestrial diameter, the weight of the earth will, by the effect of Newton's law, increase in proportion. Now the cooling goes on continuously and results in a continuous increase in the weight of the earth, and consequently brings continuous variations in the composition of the atmosphere.

All these unceasing transitions which evolution causes lead us to rectify formulæ grafted on the lack of corre-

spondence among phenomena, and on the language that attempts to express them. We say 'We are; the world is,' yet everything is constantly changing. There is nothing in the universe under whatever aspect we envisage it which is other than merely transitory. The human phenomenon, like all other phenomena, can be nothing more than the transition of a provisional arrangement of eternally shifting elements into some new arrangement. We shall seek in vain any dividing line between one phenomenon and another. Nothing can be conceived which is not infinite progression. Man had to create his god in order, by implication, to obtain some fixed point; and, furthermore, in order to give that divinity employment, he had to install him in the center of human activity. But the famous doctrine of 'motionless motion' could not be made to apply to man, for whose sake it was invented, unless it evolved *pari passu* with human evolution. No one could possibly count the gods of history. Christianity appropriated the God of the Bible. How far it is from the wrath of Jahveh to the universal mercy of Christ! And how different is the Christ of the present Rome from the sorrowful victim of Golgotha!

The complexity of the trajectory of the earth and the continual shifting of the poles are merely forms of the activity of a whole in the composition of which our existence is entangled. The rhythmical movements of the crust of the earth, which is governed by the solar heat and by the elasticity of the planetary globe which responds to the attraction of the moon and of the sun, show compound superficial variations complicated by the ebb and flow of the central core and disturbed by the eruptions of our volcanoes. Weight affects a horizontal thread, however taut it may be stretched. Even the light-ray does not travel in a strictly straight line. We picture a light-ray by conceiving it as a wave. 'The very edge of a crystal,' writes Berget, 'is not a straight line.'¹ If the problems of the edge of a crystal, which are quite simple in appearance, give us a view of the shifting intricacies of all relations, what a labyrinth we shall

¹ Berget, *La Vie et la mort du globe*.

find the combined activities of heat, light, electricity, magnetism, radio-activity, and of life, the wonder of which we have simply summed up in the word 'divinity,' which with good reason, we have forbidden ourselves to analyze.

I think that I have said enough of the radio-activity of the earth. Radio-activity certainly seems to be a general property of matter, the special characteristic of which is that it liberates helium. Sir William Ramsay suggests that it results in the transmutation of metals one into another. We shall do well to wait for that idea to be confirmed before we accept it. The problems connected with the disintegration and the integration of matter are merely at their beginnings. It would be too dangerous to anticipate their solution. For my part, I hold with the conclusion of Berget: 'If there is atomic decomposition or disintegration, there must certainly exist a compensatory integration, which would assure perpetuity.' So rapid has been the recent progress of knowledge that, amid so many hypotheses, it is important to give the valuable element of verification time to make itself felt.

Although it may be halfway between wisdom and folly, what seems to me most encouraging in the enterprise of determining the nature of the universe is that our means of verification are increasing, and that scientific proofs exceed our hopes. Has not Wilde, an English scientist, with unshakable confidence in his theories of terrestrial magnetism, made, through the miracle of a powerful imagination, a complete magnetic map of the world — a map which automatically reproduces in the minutest detail the natural force of the magnetic elements at different points of the earth? 'Thus,' writes Berget, 'for the first time it has been found possible to reproduce in all its details, and with all the circumstances of its variation in time and in space, a natural phenomenon so exceedingly complex as terrestrial magnetism.' Is it possible to conceive a more decisive proof of the accuracy of our knowledge than that purely human realization of one of the aspects of the Cosmos, according to the interpretation of human relativity? The reader will

find in Berget's book the series of able essays by Wilde which progress step by step from the theoretic view to the skillful disposition of a mechanism representative of cosmic activities. The book is a continuous succession of marvels. And what a happily ordered effort it displays in completing its task! Whoever needs encouragement will find in this scientific venture an incomparable source of the deepest satisfaction.

If we are to continue to observe the sun, it is necessary after having studied the lithosphere to undertake the no less absorbing study of the hydrosphere and its movements. We are adequate to the task. The waters cover three quarters of the surface of the earth. From what remains of the whole liquid envelope the transition is natural to the globe-encircling atmosphere, the motion of which is lost in the intra-astral dilution of an eventual substratum of ether, where the conditions under which movement occurs are unknown. The flow of the molecules when in a liquid state is revealed in the lunar-solar tides, according as their complexities are grouped. The only thing about cosmic waves which seems important to me is the fact, first pointed out by Laplace, that their effects do not lose their characteristics, and that they are superimposed rather than combined. The atmosphere is an ocean of gas lying above our ocean. In it we again find the same universal forces at grips under different conditions of substance and environment. Light waves, sound waves, electric waves, and magnetic waves are thus propagated without interfering with one another. The volume of the ocean is one billion three hundred million cubic kilometers. The volume of the continents that rise above the sea is a hundred million cubic kilometers. Allowing for the uninhabitable areas, the solid part on which we can build our proud structures is in comparison with the Cosmos almost imperceptible.

THE EVOLUTION OF THE STARS

Everything moves. It follows, therefore, that everything evolves, that is, unceasingly moves in a direction

determined by the law of least resistance. Disordered movements could not produce the unbreakable order that we see. To make a beginning, it was necessary either to draw the world out of nothingness — as if nothing could produce something — or else to invent 'chaos,' a preliminary creation of an incoherent mass out of which was to come a revised and corrected creation of a Cosmos. As soon as our knowledge was coördinated, it supplied us with an understanding of the course of phenomena, as a basis for scientific generalization. Until that time, man was bound to generalize, as luck might guide his imagination, before he could trust to his experience of facts. Thus came into opposition two contradictory mental states which make the torment and the beauty of our existence.

There is a vast gap between looking and seeing. With its sightless stare, the enigmatic blue vault tormented us with a torrent of light, which blinded before it enlightened us. Interrogations followed from man, that most contemptible element whose personal sensibility made it without a rival in its acute consciousness of the unconscious immensity. While we were waiting to raise ourselves to the first syntheses of knowledge, we were subject to a law which compelled us to a groping ignorance varied with compensations that revealed fragments of provable explanations. In that sense mis-knowledge was merely a preparatory phase of knowledge in the chiaroscuro of our relativity. Furthermore, any supreme achievement of the intelligence must always contain an element of doubt — the necessary complement of a state of knowledge never to be completed.

Amid infinite space, the infinite whirlwind of worlds in the very heart of which we live warns us that certain obscure regions will halt the frail efforts of our most enthusiastic investigations. At points ever more remote in immensity our inquiry is blocked less by the obstacle of the elements than by the inadequacy of our means of investigation. Unquestionably we evolve, and, as we evolve, our ability to learn steadily increases. Our development, nevertheless, remains relative, and it is against the infinite, be-

tween which and ourselves there is no conceivable stopping-place, that we must measure ourselves.

At every imaginable point our Known and our Unknown constantly clash. The sun of the Known can always increase without decreasing the infinite Unknown. Partisans of the absolute may complain, but seeking to know what falls within the scope of our understanding will nevertheless be a fine use to make of our lives. Since the universe is without conceivable limits, and assuming that our scientific laws are constant at every point in space and time, we shall, as we pass from one stage to another, constantly find ourselves inevitably engaged in inductive determinations of fact, which seem far beyond any possible forecast. Except Jean Perrin's highly remarkable study of atoms, I know no work better fitted to open our minds on these matters than the 'Evolution of Worlds' by the celebrated Professor Arrhenius.

The evolution of worlds! Well, yes! Quite logically the posterity of Pithecanthropus began its inquiry with that problem, since the movement of the stars must have attracted its attention first. Now, after much blundering among myths, it is precisely to that apparent starting-point that our scientific investigation of the Cosmos inevitably had to return. What, then, is the problem which confronts our methodical research, and how should we attack it?

Throughout all space fiery projectiles of all kinds and of all dimensions are forever spinning in unending revolutions, succeeding and connected with one another in infinitely recurring cycles. Collections of imperceptible cosmic dust are thrown off in incalculable masses from suns and stars; unions of monstrous suns with immeasurable nebulae occur; there are dizzying solar systems with trains of living planets, profusions of stars (white, yellow, or red, according to their age) in constant danger of collisions with dead stars, as occurred in the case of Nova Persæi; there is the disconcerting diffusion of the luminous fogs which form nebulae; these are the palpitating flashes of the perpetual lapidation of the meteors which in tempests of volatilized flames fly

from one world to another; there are comets of every size, falling stars,¹ auroræ boreales swaying their veils of light, and finally there is the bedazzlement of milky ways. Meanwhile, volcanoes make our extinguished planet tremble; fiery lavas flow over it, tidal waves destroy its shores, and yet its ordered profligacy is crowned with the splendors of life, of feeling, and of thought. Definite relations must exist among these phenomena. What can we know of them? Whether through observation or through hypothesis, what degree of 'knowledge' can we attain? What is the history of these stars? How can we generalize about their lives? What philosophy of the universe can we frame? How will our attempt to fathom the mystery of its secret affect us?

Hard work has disclosed the elementary facts of the Titanic outbursts of the immeasurable convulsions of nature, but the most powerful imagination can form no picture of them. The feat of making a preliminary generalized sketch, limited to the salient points of such a picture, has tempted great intellects. In spite of the admirable progress of recent science, the enterprise must be perpetually renewed. Following in the footsteps of many others, Arrhenius tried his luck and met with some success. Readers who wish to go beyond the scope of my brief notes will never regret it if they study his work.

The astronomy, the physics, and the chemistry of stars, which are suns in various stages of evolution, are capable of extensive development. The star which is the center of our solar system requires most thorough-going study. Merely to point out some of its elementary relationships, I will limit myself to a few established facts. I refer readers to the astronomy so wonderfully set forth in the work of the learned Swede.² Photosphere, chromosphere, spots, prominences.³ I put aside all analyses of the solar phenomena;

¹ Twenty thousand tons of meteors and of shooting stars fall on the earth annually.

² *L'Evolution des mondes.*

³ From five hundred thousand to eight hundred and fifty thousand kilometers in extent.

I limit myself to noting that the system is traveling toward Hercules at a velocity of twenty kilometers a second. Arrhenius at first suspected that we must run a strong chance of colliding — as happened in the case of Nova Persæi,¹ in which we actually saw two heavenly bodies crash into each other. Numerous, and no less unmistakable, cases have occurred. In the fantastic adventure we must concede them something more than an accidental value.

All life and all planetary movement except that of the tides depends on solar radiation. Must not the reserve energy of the sun become exhausted? We know that the greater part of that energy misses the planets and is lost 'in the unknown spaces of the frozen universe.' It has been calculated that the sun loses every year two degrees of temperature. Since the temperature of the surface is seven thousand degrees, the sun should long since have been cold. If it is far from being so, 'the reason must be that its income of heat is substantially equivalent to its expenditure.' Theories have never been wanting. I shall take no part in the debate. Our innumerable stars — there are a thousand million in the Milky Way alone — are so many suns, more or less hot according as they are white, yellow, or red. The spectroscope makes possible a fruitful study of their chemical phenomena, and from that study we have derived important light on the component elements of the sun at different stages.

The average temperature of the sun is estimated at six thousand degrees, an amount of heat sufficient to supply present calorific radiation for three million years. That is a trifle, however. Thrown out from the center to the circumference, fragments of the mass instantly decompose like our explosives and liberate an enormous amount of heat. Arrhenius declares that there is enough to maintain the temperature of the sun 'for four thousand million years,' and perhaps much longer, probably even for many billion years. To me it seems venturesome to discuss any such eventualities, especially as we cannot yet determine with sufficient

¹ 'Novæ' are new stars born of collisions.

precision the time at which the formation of the sun began. In general, scientists agree that there is a date of expiration. That is ample basis for inductions as to the future.

The fact is that the sun is cooling. To what exact extent, as a result of that cooling, will the living organisms of our earth some day diminish? That is of only secondary importance. Since the universe is manifest only through its changes of temperature, the severe cold which will end the existence of our posterity will, in the course of the cosmic cycle of successive evolutions, renew the transient coördinations which, in incalculable time, will carry back cosmic matter from the concentrated form of extinguished suns to the extremely dispersed form of the nebula, mother of new suns. That will happen through the inevitable collision of heavenly bodies which, in accordance with the laws of time and of eternity, will restore to planetary and stellar motion its previous forms.

That on this point the hypothesis of Laplace should have lost its initial luster is not surprising. Along with Kant, my distinguished countryman will none the less share in the honor of having glimpsed and even defined the evolutionary tendencies of the cycle of the universe — so thoroughly confirmed by experimental proof that even regions inaccessible to our view cannot escape them. The alleged 'bankruptcy' of a science which illuminates regions beyond the possible reach of our senses, while the fairy-tales of 'Revelation' grow unreal and pale, proves that man may be carried by imperious evolutionary action to a point which decisively justifies scientific knowledge.

That does not mean that the hypotheses of Arrhenius and of so many other scientists, which have succeeded those of Laplace, and which, like them, are founded on the interpretation of recognized laws, will not share the fate of previous conceptions, for they, like their predecessors, are constantly subject to reshaping through observation that can never be brought to completion. Recent discoveries have carried us so far in the understanding of cosmic relations that we cannot help yielding to the irresistible desire to ex-

tract from them the starting points of superior coördinations which, though never attaining the absolute of comprehension (if the term has any sense), sweep us on without pause to ever more precise approximations. If for that reason we do not give way to the temptation of becoming lost in self-worship, we shall nevertheless end, with or without Pascal, in raising rather than in lowering ourselves in our own esteem.

If that be admitted, there can be no question of going into the calculations of Arrhenius or of any one else any more than into those of Laplace. The modern scientist has at his disposition marvelously improved means of investigation. It is not astonishing that already there should be established conclusions which not even our imaginations could formerly have pictured.

In 'The Evolution of Worlds,' the reader will find a striking exposition of the successive phases of solar cooling, which notwithstanding this serious discrepancy proceeds *pari passu* with the cooling of the earth: throughout the geological ages the sun never ceased to lavish on us an amount of light and heat greater than any it sends us to-day, whereas nothing any longer comes from without to restore heat to the dispensing star, already on its way to extinction. The phenomena consequent on its cooling must necessarily be hastened.

What a spectacle it will be when, as happened on the earth, the condensation of water vapor makes seas rain down to form solar oceans in a monstrous water-spout. Ice will follow. Solidified carbonic acid will be deposited in the form of a fine white snow. And when the temperature falls to -200° , new seas will form as a result of the condensation of gases — notably nitrogen. Meanwhile, under the newly formed crust in the interior of the solar globe the temperature will still be similar to that of to-day, say, some thousands of degrees, and there will exist every possible explosive combination beyond human power to estimate.

At this point comes up the inevitable incident of collisions between extinct or luminous stars. Arrhenius calculates

that the collision of the sun with another star of the same character should occur only at the end of one hundred thousand trillion years. The period might be materially shorter according to the unknown number of extinct stars which continue to circulate through space awaiting renovation. It is much more probable that the sun will hit some nebula with a prodigiously extended gaseous field, but with negligible results unless the nebula contains a considerable quantity of celestial bodies, either dark or luminous, the activities of which would inevitably have a marked effect.

New stars are discovered almost every year. From time to time, as a result of collisions, we behold novae suddenly kindle. After shining with a vivid light, their brightness gradually diminishes. Such was the fate of Nova Persæi, which at first attained almost the brilliancy of Sirius, but which has to-day fallen to the rank of a star of the twelfth magnitude. The spectrum discloses many analogies between that nova and another new star, Nova Aurigæ. Still another, Nova Cygni, presents points of comparison. Naturally, the spectrum in these cases is very valuable. It is the task of scientists to interpret these phenomena. To analyze what is passing in stars at least a hundred and twenty light-years¹ distant from us is an arduous undertaking.

We cannot see the collisions between stars, but we have enough elements of the problem to reconstruct the phenomenon and to infer some of the determining data in the domain of mechanics, physics, and chemistry. We need only refer to Arrhenius' study to ascertain the story of the formidable explosions and of the gaseous dispersion which formed the stellar nebula. Photography defines the curve of the spiral described by the gaseous projections from the pole of the agglomerated stars. Stellar nebulae, planetary nebulae, nebulous light and spiral nebulae, which are the most common, are scattered everywhere. Such are the nebula Canes Venatici, or the Triangle, the annular nebula, the Lyre, the great nebula of Orion with its enormous masses

¹ A light-year is the distance traversed by light in the space of a year — approximately ten million million kilometers.

of cosmic dust, the nebulous bands of the Pleiades, the nebulous trail of Cygnus. All testify to violent explosions, perhaps surpassing in speed the formation of the solar prominences.

There is nothing surprising about the profusion of meteors or of the cyclones of cosmic dust which the pressure of radiation projects into space. Great stars may spend millions of years in crossing those fields of nebulousity in which white-hot bodies are grouped or scattered. Nebulæ may even assume the likeness of star clusters, grouped in the familiar forms, to which spherical or wedge-shaped arrangements are sometimes added. Collisions between gigantic suns like Arcturus produced a huge nebula near the Milky Way. Empty spaces, rents, and black holes raise questions thus far unanswered. Variable stars like Argus or Mira Ceti still baffle those astronomers who want to explain everything. Dark stars necessarily circulate in great numbers throughout the Milky Way. In that region collisions are necessarily more frequent. Nebulæ may consist of aërolites of every size and even of stars and may assume all manner of shapes.

By determining temperatures, the spectroscope is of value in the analysis of the transformations of gases. Of these there is no end. Hydrogen, helium, perhaps nebulum, carbon, sodium calcium and iron in gaseous form cause these transformations. Series of stars at the present time represent phases of evolution differing but little from those of the nebula. In the immense laboratory of infinity the elements pass before us in review. We recognize that the stars are evolutionary phases which are alike or which differ, and which accordingly permit us partially to grasp their relationships. Temperature is always the dominant factor. Here we touch once more the problem of problems: Is the energy of the universe decreasing?

Carnot's famous principle, formulated by Clausius, has led us to this question. Does the universe, which neither time nor space can measure, evolve towards a thermic equilibrium which will end in thermic death under the

formidable law of hypothetical 'entropy'? Poincaré admits that this term is 'prodigiously abstract.' Coming from such a man, the admission is not to be overlooked. Words do not frighten me. Whether they issue from the church or from the laboratory, they must, in various forms, define the relationships of activities. In fact, entropy is no more than an explanatory formula, expressing the idea that all movement tends to be transformed into heat, and that heat tends to distribute itself uniformly in all bodies. That is what Arrhenius means when he says that 'we interpret entropy as the quantity of heat contained in a body divided by its absolute temperature.'¹ Clausius, who coined the word entropy, is unquestionably a great scientist; that does not confer on him the authority of 'Revelation.' Like any other scientist, he must supply proofs. Why did he not begin by making his entropy conform to the evidence, which shows us the universe perpetually renewing itself, and which therefore requires that in the infinite course of the ages cosmic movement must long ago have stopped on a dead-center?

Many raised that objection. I do not see that any one has tried to answer it. 'It is very painful,' writes Le Dantic,

¹ The two principles of thermodynamics declare: one, that matter and energy are indestructible; the other, that activity wears them away, or dissipates them. Many persons have preferred the phrase 'degradation of energy' (Brunhes accepts it), because by using it they hope to make the contradiction less striking. As a matter of fact, the word 'degradation' smacks of subjectivity, for the idea of a hierarchy of grades among phenomena is based on human subjectivity.

It seems much simpler to admit that the actual state of our observation does not as yet permit us to follow in all its phases the dynamism, of which the principle of Carnot affirms, not the 'degradation,' but the 'disappearance.' The difficulty is that because the latter word emphasizes the contradiction between the two principles, our scientists (who are only human) have found it easier to formulate a theory than to await the result of unfinished researches. Brunhes himself, who would have it that the material world is wearing out, and that phenomena become less and less striking, insists that 'we carefully avoid speaking of the entropy of the universe.' None the less he brands the famous formula: 'nothing is created, nothing is lost,' as a lie. When the two great principles of thermodynamics have been reduced to those terms, I cannot find that anything is left. Some day we shall bethink ourselves that entropy (I mean entropy of the universe) was begotten in the delirium of metaphysical interpretation. Already everything indicates that there will be no lack of theories to take its place.

'to hear mathematicians say that there is in the world something which constantly increases, the nature of which we cannot know. Entropy may be regarded as a purely mathematical notion, for which no equivalent can be found in human language. We are the more annoyed by the impossibility of translating the term because, from the constant increase in this no-one-knows-what which we do not understand, certain philosophic physicists have drawn conclusions about the end of the universe.'

I accept entropy, then, only as an hypothesis, the experimental study of which will some day bring us face to face with a body of verifiable knowledge. If evolution is the chief cosmic principle, and if the law of evolution is to bring us to a cessation of universal movement, what is the source of the activities of those stars the course of which thermic eternity has not been enough to arrest? It is not surprising that after a first shock of astonishment scientists were inclined to oppose such a theory.

Arrhenius does not admit that our present theories of thermic action apply to *nebulae*. And, since *nebulae* in their evolutions cannot be wrong, the conclusion is obvious that there is some flaw in our theories. The first principle of thermo-dynamics requires that cosmic energy be constant. But we find that entropy — the Nirvana of the universe — tends towards a maximum, and certain persons prefer to let the world come to an end rather than admit that their knowledge is only fragmentary — a limitation that would not permit them to settle the matter of infinity. Have we overlooked some new law? It would not be the first time. Science has not led us out of the limbo of absolutism merely to lead us back into it again at the first turn of the road. The counter-hypothesis of Arrhenius — namely, that the lost heat is recovered through astral collisions — has the merit of close relation to the whole connected body of cosmic problems and of constantly remaining open to verification. Knowledge, so-called, is the possession of relative truths, attained through experimental methods and bound together by inductive reasoning. Decreeing some kind of

absolute as a result of inadequate knowledge is simply a pompous form of ignorance. For learning there is nothing like century-long, or even thousand-year long patience; all we need do is wait long enough.

The celebrated physicist, Maxwell, seeking new guidance, wittily imagined a case in which little demons, equipped with good, tight valves, let every gaseous molecule animated with a velocity greater than the average velocity of the whole pass through a screen, while holding back all the others. By that ingenious contrivance heat — that is, movement — would be transferred from a colder body into a body continually growing warmer. In that case, entropy — the tendency toward thermic death — instead of augmenting, would diminish. Our only concern, then, is to find a way to substitute some kind of automatic energy for the discriminating power of the little demons. It is the old story of Providence and of Newtonian automatism.

Poincaré declares that he has never been 'at all disturbed' by entropy. For him, that formidable 'principle' is 'merely a concession to the fallibility of our senses.' And, indeed, the ultra-microscope reveals the Brownian movement, in which some persons at first thought they had discovered a 'vital' phenomenon. It was, however, perceived that dead corpuscles 'were as lively as the others.' Other persons thought they had discovered in it the effect of the development of heat, due to illumination by the diffusion of light. But the movement proved to be all the more lively when the particles were small. And, Poincaré hastens to conclude: 'If the movements do not cease, or, rather, are incessantly renewed, what conclusion must we reach? . . . We actually see movement sometimes transformed into heat, and, inversely, heat sometimes transformed into movement, and that takes place without loss, since the movement lasts. It is the contrary of Carnot's principle. . . . The bodies that are too big, those which, for example, are a tenth of a millimeter in diameter, are struck on all sides by the moving atoms. However, they do not move, for the shocks are very numerous, and, by the law of chance,

they offset one another. But the smaller particles receive too few blows to be sure that the blows offset one another, and they are, therefore, incessantly knocked hither and yon.'

Molecular attraction and repulsion produce in liquids symmetrical forms such as the crystal, the plasma, and the cell itself.¹ And when the colloidal state reveals its molecular groups of micelles, trembling with a Brownian movement, it becomes obvious that the protoplasm and its cells in which the first manifestations of life are found are not very far away. From the organic properties of the plasma and of the cell in vegetable and animal tissues spring all the co-ordinate phenomena of 'vital' energy which, by means of the clashing of hereditary and environmental impulsions, coöperate to maintain and to develop the organism to the point at which it achieves consciousness and becomes capable of thought, together with the accompanying progressive activities.

I have recorded the fact that, with the increase of knowledge and under the unconscious rule of cosmic law, the gods vanished. Maxwell's ingenuity subjects his 'little demons' to the same fate. All that remains is to find the series of positive phenomena which will lead to the same result. Arrhenius observes that the celestial bodies in gaseous form — say the *nebulæ* — present a precisely analogous case. He says: 'When the molecules of gas that make up the atmosphere of a celestial body have a sufficient velocity (namely, eleven kilometers a second in the case of our globe), and when they find themselves in the outer layers of that gas, they escape its sphere of attraction, and continue their way toward infinite space.' That is how a comet escapes from a solar system. The moon probably lost its atmosphere in that manner. Thus do the *nebulæ* lose along their peri-

¹ I refer the reader to the absorbing work of Yves Delage on 'Heredity and the Great Problems of General Biology.' He will find there stated, followed up, and sometimes solved, innumerable problems which will enable him to understand why metaphysics finds it simpler to attack the study of life by assuming a useful 'vital principle,' which may be set to any task, than to undertake laborious scientific experimental research.

pheres the molecules which have the highest velocity — a process which cools the layers farthest from the center. At that pace, we shall soon reach thermic death. But, 'there exist in the nebulae numerous immigrant bodies which have condensed the gas around them and which consequently have a higher temperature. Wandering molecules may, moreover, attain the very thick atmosphere of these stars of great growth, and the effect would be to accelerate condensation, which would be accompanied with a constant diminution of entropy. By similar reactions the mechanism of the universe could be kept in constant motion, without ever coming to a stop.'

The hypothesis seems very plausible. Whether confirmed or not, it is enough to indicate what alternatives are open, if we wish to avoid the absurdity of thermic death. In that respect, the nebulae afford an unlimited field for observation. Bravely the scientist enters upon it. I need not follow him in the analysis of the rarefied gases of the nebula and of their temperature, formation, and activities. I need only point out a few characteristics, in order to bring out at their true value the changes in the condition of phenomena: 'Assuming that the absolute temperature of the nebula was fifty degrees (-223°), the vapor of mercury, the most volatile of all metals, would, even in a state of saturation, have so little density that a single gram of it would occupy a cube which it would require approximately two thousand light-years to traverse. That represents a distance four hundred and fifty times as great as the distance between the earth and the nearest fixed star. As for sodium, which is also a highly volatile metal, and which is an important constituent of the stars, the side of a cube that held a gram of it would be almost a thousand million times greater. Iron and magnesium, which often occur in the fixed stars, and which are less volatile than the two metals already mentioned, give us figures still less conceivable.'

It seems fair to assume that we were dealing with a different world from our own, and that even if the substances were chemically identical, the difference of state would be

so disproportionate that we should have no means of measuring relationships among activities which are beyond our comprehension. Yet it is to these new limits of observation that we must apply our minds, if we are to gather and compare the unsuspected truths of an experience beyond human dimensions. As Herbert Spencer forcibly points out, everything tends to make us expect that the evolution of the world goes on toward the achievement of a cycle, which is the supreme expression of the Cosmos. Our task is to set up enough guide posts so that some day we may be able to infer from them in what direction cosmic evolution is tending, not indeed as a whole, but in terms of such fragments as we are able to study.

'We find,' Arrhenius concludes, 'in the cold, gaseous, diffused part of the nebula the element in the mechanism of the universe which balances the prodigality of the suns in their expenditure of matter and especially of energy. . . . Thus every ray of heat coming from the sun is absorbed, and the energy which it carries is transmitted by the gaseous elements of the nebula to the forming suns — which may be close to the nebula or contained within it. That energy condenses on the centers of attraction already contained in the nebula. . . . The intense cold which prevails in those regions permits matter to agglomerate anew. . . . Energy can concentrate, contrary to the law of the continuous growth of entropy. Those preservative effects allow the gaseous envelope to become rapidly rarefied. It will then be replaced by new masses of the same matter, rising from the interior of the nebula, and continuing to rise until no more remains, and until the nebular form is replaced either by a cluster of stars or by a planetary system revolving around one or many suns, the collisions of which will in their turn create new *nebulæ*.'

The reader will understand why I have felt obliged to quote the text. It is not incumbent on me to discriminate here between verified hypotheses and hypotheses set aside for future verification. No knowledge, however well established in our time, has been built up in any other way. I

should not wish to deny that the word entropy may represent a point in the evolution of things. What I will not admit is that it will close the account of the universe. The word has appealed to scientific minds because, as Le Dantec observed, it represents a mathematical value which, without experimental verification, can provisionally be adapted to mechanical conceptions. Although science has pronounced its verdict, an appeal therefrom may be taken.

The time has gone by when, threatened by the burning brands of the Church, scientists painfully relieved one another from century to century, only to progress along a line of dubious verbalism which was often found wanting when confronted with later observation. To-day, in all civilized countries whole regiments are investigating man and the world which produced him. It is hard enough to follow them even at a distance. Far from public clamor, they constantly heap up their labors, the value of which we appreciate through flashes of human comprehension revealing what our intelligence has built up, and strengthening those components of our individual and social life which are the concrete expressions of our efforts.

That is the tribunal which tries every experimental suggestion. Verification is the test of the scientific value of the work of Arrhenius and of every one else. Any one may at some time go astray, but will none the less serve the cause of knowledge by blazing its path, and we are grateful to him. The proud dignity of his inner satisfaction will raise him above human 'rewards.' Whatever happens, thinking man, by his splendid efforts, will have developed himself in the full light of elementary action. He will have willed, he will have spoken, he will have acted. The sun may meet with provisional extinction. It will have shone.

THE DYNAMISM OF EVOLUTION

Let us compare the schematic man of the Bible with what observation of the tangible facts shows us about our present humanity. In different degrees, the same organs, the same tissues, the same plasma, the same elements, the same func-

tional activities, and the same chemical combinations are present throughout the whole series of animal life, including man. This similarity requires explanation. We must eliminate chance from consideration, for chance contradicts both the idea of an eternal Providence and the scientific fact of the interrelation of phenomena. Similarly, I discard the ridiculous notion of 'economy of means,' which, in the case of Almighty Power, is absurd, since economy could interest none but a being of limited faculties.¹

The successive development of primitive organisms asserted and confirmed by all scientific observation emphatically attests the interdependence of phenomena, the irreducible connection of which can be explained only through the ceaseless action of 'evolution.' It is the very action of evolution that, at every degree of organic and even of inorganic generation, is encountered in a connected action, still scientifically uncontradicted. To this day no one has dared raise any such objection.

Assuredly, the general phenomenon, admitted in its broad outlines, does not solve all the problems of the universe, as does the word Providence, before which we can but prostrate ourselves. Far from being an all-inclusive solution, evolution in all its aspects presents innumerable problems and opens an enormous field of research. Knowledge must necessarily change its bearings. All the problems of the organic and inorganic world are before us. Where are we to find a criterion by which to measure our interpretations? The discussions of transformists of every school make it evident that from the time of Moses the question of elementary dynamism has undergone perpetual change. Now we have a compass, and we can set sail.

Nevertheless, the priesthood is still obsessed with the theses that preceded scientific observation. It still follows the *via dolorosa* wherein its chief torture should be that

¹ Firm in their belief in the Biblical creation, the enemies of evolution none the less accept the sacred legend that places the beginning of human life in a fall, that is, in the regression of a reversed evolution. Observation, on the contrary, leads upward from the cannibal to Saint Francis of Assisi.

it has tortured. Metaphysics itself seizes upon transformism only to disfigure it. It is the last despairing effort of a hopeless resistance. The Church had to resign itself to the geological transformations of the planet. It should now resign itself to the evolution of life. And still other sacrifices will be required of it.

More centuries than we can count had to pass before man, after hastily passing judgment on himself and on the world in the complete darkness of his intellect, made up his mind to look before he spoke and even to take back what he had said when everything combined to show him that he had spoken mistakenly. Before his eyes stretched the whole scale of ascending life, culminating in the human representative of evolved existence. And until modern times not even that spectacle had suggested any attempt at coördinated observation. He had to have water-tight partitions between every two phenomena of the same kind, when, to-day, their infrangible connection is obvious. On his own authority, he isolated them. The apparently immobile crystal does not disturb his prejudices overmuch in spite of the degree of individuation which permits the 'inorganic' to heal its own wounds within the limited field of its coordinations. But the living cell, the phenomenon of life which in the organic sequence leads through every stage to the crowning development of man seemed to him a higher 'miracle,' accompanied by the lesser miracles of the separate creation of species. He had an invincible prejudice against recognizing any bond among phenomena, though the most elementary experiment proves that they are strictly connected.

What was the explanation of that strict sequence of the processes common to embryology, anatomy, physiology, and pathology? Man could not bring himself to investigate. How account for that consciousness which in successive living creatures advanced from the lowest point to the highest? Man did not heed it. Was he struck by the fact that as we follow the course of cerebration upward through the scale of life, all its manifestations are analogous? Not

for a moment. We hear of the 'creation' of man, the schematic man, metaphysically 'one,' when, on the contrary, he is very different according to his environment and to the comparative development of his organs. Instead of this human uniformity, we see races of men at very different stages of consciousness, the most ancient of whom, with a consciousness inferior to that of our contemporary savages, ranks nearest the animal in the scale of living organisms. Should that not provoke reflection? Man did not reflect. The skull of the man of Chapelle-aux-Saints, however, together with other fragments of human skeletons, all tell an identical tale. Did not man understand? He chose to remain ignorant.

Nevertheless, no one questions what we are compelled to call 'the intelligence of animals.' And we find the intelligence of primitive man so nearly on a parity with animal intelligence that we are puzzled to distinguish between them. The fossils of Java, of Piltdown, of South Africa, of Chapelle-aux-Saints and of Neanderthal, if compared with the much farther evolved skulls of our present-day savages, are decisive on this point. And, furthermore, we know nothing of the innumerable specimens of a less evolved humanity of preceding ages. So far, our discoveries have touched no more than an insignificant part of the fossiliferous ground.

If 'animal intelligence' exists, and if the original *homo erectus* had intelligence, proportionate in both animal and man to the degree of development of the cerebral organ, can we escape the conclusion that they were originally affiliated? Step by step, the degree of intelligence rises with the rise of the individual in the animal scale — a fact that calls for the exact studies of comparative psychology. Universally we find the same efforts of an individualized knowledge, universally the same mixture of failure and success — a mixture due to the inadequacy of the organism or to a check in the potential evolution of certain branches. Animals are caught in all manner of traps. So are men. The majority contrive to avoid danger — a fact that implies

combinations of associated sensations. The mental process does not differ; the degree of efficiency does.

All living creatures face the same problems. But man, having the privilege and the ability to perform the hardest work, developed a mental training which after long failure permitted him to know more thoroughly and to act more harmoniously than his fellow animals. From the budding shoot of the tuber in the cellar seeking the light and finding it to the most fully individualized reactions of sensibility and will are only gradations toward the most distinctly reasoned actions. However great our mental inadequacy may be, however persistent may be the stubbornness of our hereditary dullness, nothing better explains the human phenomenon and the course of its progress than the evolutionary links which unite all the manifestations of life.

If, on the contrary, our soul is a direct emanation from Divinity, which blundered to the extent that 'perfection' felt obliged to produce an 'imperfection' inconsistent with itself in order to torment beings needlessly created, we must explain a vast amount of the inexplicable — beginning with the impossible union of the 'soul' and the body. If, on the other hand, we confine ourselves to the world of scientifically observed facts, we must accept and be governed by the unbreakable coördination of all dynamisms.

But does not observation and research involve the constant risk of mingling error with truth? Indeed it does. However, the error can be rectified, and even our most serious mistakes thus take on the dignity of a purely human effort toward an ever deeper knowledge which wonderfully ennoble the disorder of our lives. Otherwise — whether we are the mistake or the inexplicable whim of a 'Creator' who, lacking his creation, loses all importance — we become as incomprehensible as God himself, since, like him, we become inconsistent. If, however, we take our natural place in the scale of phenomena, we can in turn explain ourselves through the dynamism of successive interdependences. The fact that we set up false landmarks — unjustifiable from

the point of view of Providence — represents, on the contrary, a courageous effort to grasp a truth so vast that we can seize only fragments of it.

The problem of reaching knowledge by penetrating relationships and then classifying them is, doubtless, the same in the development of our organic world as it is in the rest of the universe. In the case of every creature, knowledge gradually proceeds from primal sensation to the successive stages of elementary evolution, in a field of conscious action, which is confused by an inevitable complement of misconception. Such is the fundamental condition of thought.

The coördination of elementary dynamisms requires a synthesis of tendencies, the component parts of which must themselves be prescribed. The constant correspondence of cosmic waves is what we style evolution. Let us not expect from the superficial magic of that word the key to a higher mystery as many persons still do in respect to the word 'life.' The word 'evolution' denotes no entity any more than does the word 'life.' On the other hand, there are concordant tendencies in interdependent movements. The term is merely the vocal expression of the general activity of successive phenomena registered on the sounding-board of our intellect.

A series of aspects of differentiated states are what we grasp of the universe and of ourselves. The law, that is, the constancy of related action along the line of least resistance,¹ determines our future, and upon that future we pin our hopes and our fears and the whole train of our sensibilities. In fact, through the whole range of phenomenology, our thought, or knowledge, since it is itself a succession of states of consciousness, is bound to present parallel explanations. The complex of inner waves, which constitutes the subject, harmonizes its resonance with the complex of external waves, which constitute the object; both are bound together by strictly corresponding relations. The word pro-

¹ Now more accurately termed 'the law of least action.' I prefer the less philosophic, but more suggestive word 'resistance,' which gives us a picture and presents no particular drawback.

gress, which preceded the word evolution, indicates the direction of a general process of becoming which may or may not conform to our ill-founded, ephemeral tastes.

Great minds that have sought for the limit of human achievement have not lingered over the nonsensical suggestion of a pause in eternal evolution. Herbert Spencer sees man, sprung from the primitive struggles of an organic consciousness, battling against the apathy of the unconscious elements and marching to the conquest of 'the definitive man in whom a finished individualization and perfected life will be simultaneously realized.' I can see in that nothing but a last atavistic trace of finalistic aspiration, the effect of which, as the philosopher himself says, is 'to make all law useless and impossible.'¹ The same mind, so strongly attached to the evolutionary progress of the differentiated individual, dreams of seeing that progress brought to a stop through the restoration of man to a harmony with the evolutionary action of the Cosmos, amounting to identification with it. A result such as Spencer contemplates is, properly speaking, death, for the thread of life is cut when there is no further oscillation between one phenomenon and another — an oscillation which amid our activities translates itself into the sensation of 'choice.'

Since the human Ego,² on which Spencer vainly tries to base his system, can, like all complexes, offer us nothing 'except a composite of parts harmoniously united,' it unceasingly predicates the force of its own subjectivity, because it is permanently obsessed with finalistic ideas. The thinker who so boldly recognized in words 'an obstacle to thought'³ became a victim of the evil he pointed out — a finalist in spite of himself, because he was haunted by a dominant subjectivity in which he included the Cosmos without consulting it.

After having recognized that the world is in unstable

¹ Herbert Spencer, *Social Statics*.

² There must be as many Egos as there are grades of individualization, according to the play of the constituent parts.

³ Herbert Spencer, *The Philosophy of Style*.

equilibrium, Spencer suddenly brings its pendulum to a stop at the hour when through the supreme assumption of an end that reduces his personality to nothingness, definitive man ends creative evolution. The 'homogeneity' and the 'heterogeneity' of the philosopher do not extend beyond the simple aspects of things represented by words which to-day no one is willing to accept as final. Where do we end, if we pretend to find in them the law of the universe? We become exhausted by the prodigious mental effort of seeking a 'final' understanding of all the relationships in the universe which is the supreme contradiction of our relativities.

To coördinate knowledge and never to anticipate except in hypothesis is a method which, though less ambitious, is more certain of results. However, our Ego, pulled this way and that, is not made up solely of knowledge. There are, first of all, the emotions, and in the obstacle race which has neither starting post nor finish they leap to the front at the start and aspire to lead the field. 'Universe' — our name for something without conceivable limits and consequently impossible to define — is a word meaningless except as it may represent the unknowable. It is like the notorious 'transcendency' of things, which merely means a complete failure to understand the subject.

Spencer, in his ambition to supply us with a complete doctrine of evolution, confidently and dogmatically assumes an intimacy with the beyond and boldly makes the absolute speak in terms adapted to our relativity. This adroit generalizer, after many attempts to crown relative knowledge with a theory of the absolute, placidly plunges into metaphysical jungles in which there are no more clearings than existed in the jungles in which his predecessors floundered. Listen to the distinguished doctrinaire: 'An entire history of anything must include its appearance out of the imperceptible and its disappearance into the imperceptible. Be it a single object or the whole universe, any account of it which begins with it in concrete form and leaves off with it in concrete form, is incomplete, since there remains an era

of its knowable existence undescribed and unexplained.' ¹ Who is to tell us just when our power of perception is to become the measure of things? And in the uncertainty of what is 'knowable' by man, why assume that the subjective explanation of a cosmic moment can be a measure of cosmic fact, when the entire history of human thought is a sufficiently conclusive proof of our inability to know anything of the universe except series of relationships? In spite of an unsurpassed effort at penetration, this distinguished philosopher could only begin again the adventure of all other 'creative' geniuses: namely, the construction of a world of words corresponding in no particular to observed and verified fact. Nevertheless, he had a remarkably exact sense of universal evolution, and the glory of having tried to realize the universe as a sequence of coördinated activities will remain his.

Things should, from the start, have given us primarily a sensation of movement. Of that sensation, in spite of its familiarity, we retain, and many persons still retain, only a certain terror of the unknown. Out of that terror came the persistent search for some fixed point which, though only schematic, still offered the masses the advantage of an apparent security. To desert discoveries fictitiously grouped for the scientific establishment of concordances the terminations of which escape us requires an inflexible unity of mind and of heart. On the other hand, the composite of relativities which guide our energy generally tends to maintain the fictitious supremacy of the subjective over the objective. The 'philosophy' of Spencer is an exceptionally fine attempt at reconciliation. That is why I pause over it. However, how can we accept this definition: '*Evolution is an integration of matter, and concomitant dissipation of motion, during which the matter passes from an indefinite, incoherent homogeneity, to a definite, coherent heterogeneity, and during which the retained motion undergoes a parallel transformation.*' ²

We soon ceased to consider evolution as 'a redistribution

¹ *First Principles, Evolution, Dissolution.*

² Spencer felt it worth while to underscore this sentence.

of matter and of motion.' The formula may prove surprising. But what meaning can be accorded it when it implies relations between matter and motion which can be defined only by words having no established objective reality? What positive sense can be given to intangible integration and disintegration? What is meant by the so-called 'transition from a less coherent to a more coherent form,' when the universe is wholly made up of an eternally changing coherence?

Whoever aspires to master the complete truth should first ask himself whether he is prepared to assimilate it. Spencer wanted to outstrip science, and he necessarily stopped to create for religion a hybrid place halfway between the known and the unknown — a circumstance that earned for him a tomb in Westminster Abbey. Even now, to set aside for the interpretations of religion a share in the scientific explanation of the universe and at the same time to pretend to solve the problem of the Cosmos independently of religious explanations is so glaringly inconsistent that we can hardly explain it to ourselves.

'Unless we succeed in finding the reason of this universal metaphor, we obviously fall short of that completely unified knowledge that constitutes philosophy.' Is that the 'whole problem of science'? Our trained modern intellect is no more in a position to assimilate the whole Cosmos,¹ than were the untrained intellects of our ancestors, proud of their ignorance. Whence, then, do we derive the right to confer on ourselves the means of 'succeeding,' through the virtue of words which correspond to no objective reality? We willingly admit that we find ourselves in the presence of an incomparable 'metaphor.' Why, then, should we impute to it a living reality and then accept the illusion of it for the sake of having the right to philosophize? Is it not more worth while to admit that in attributing life to their symbols, men have let themselves founder in a treacherous phraseology which only too obviously led them from the

¹ The statement is senseless, since we are incapable of conceiving the limits of the universe.

path of tried and tested experiment? When Spencer declares that in the last analysis he believes 'that evolution cannot come to a stop except through the establishment of the greatest degree of perfection, and of the most complete felicity,' what is he doing except imposing on the universe a mandate issued by his own subjective self?

After having explained the universe by matter and motion (as did Descartes) Spencer, wholly on his own authority, breaks the infrangible succession to which he had at first confined himself (again like Descartes), and which, for the sake of invoking an 'unknown cause' through which the cycle that he himself claims to close, is bound to reopen. In that lack of balance we see the finest efforts of a noble mind atavistically resume the discarded yoke. It is the anthropocentrism of the primitive ages. Moses was excusable. Since his day, what use have we made of the lessons rendered available by experimental science?

Is then the idea of evolution, which is still too frightening to many bewildered minds, so disconcerting? It is, in fact, only a question of interpreting the earliest sensation of organic life in contact with the moving world. Whether we speak hesitatingly or dogmatically about the universe, we always end by seeing it as a chain of linked activities. We can discover nothing but the divers results of a universal dynamism in which everything is uninterruptedly attached to everything else. Whether or not we use the name of evolution to designate the activity of the elements, we cannot find a movement which is not inevitably connected with an antecedent and a consequent. The inorganic and the organic world are no more than different states of a whole, the modes of which no more alter their nature than do solids, liquids, or gases, with their characteristic dynamisms.

The world moves; therein lies the universal phenomenon within the limits of which our knowledge is confined, since we can know only determinate movements that as they occur permit our subjective classifications to establish the trend of their relations. Evolution is no more and no less

hard to understand than gravitation, light, electricity, or any other form of cosmic energy.

The word transformism, which is more concerned with superficial appearances and exterior manifestations, is less suggestive than the word evolution, in which is implied the dynamic connection between the phenomenon which precedes and the phenomenon which follows. To evolve is to develop conformably with the harmonious laws of the organism, and of the environment. For us, those laws reveal themselves in successive relationships, governed by a fixed tendency. Whether we seek their cause in volitions exterior to them or in abstract entities which we have endowed with reality — like the *élan vital* of Bergson, or the *puissance dormitive* of Molière — we none the less arrive at some composition of least resistance which determines the tendency of development. Such is the 'universal gravitation' of the astral masses, which recurs in the atom and in its electrons.

Only at the price of painful effort did the idea of evolution, — that is, of a coherent body of cosmic activities, without which there would be no universe, tardily recognized by its manifestations in the organic order, — slowly overcome the obtuse resistance of primitive conceptions. Many who proudly acknowledge that the human mind progresses — that is, evolves — are slow to accept the verified march of phenomenology in respect to this organic development of knowledge. They admit the theory, but they balk at the idea that they are descended from Pithecanthropus. Even so, their respect for the human form has not prevented the 'faithful' from subjecting God in his human likeness to bestial slavery. It has been wisely said that it was better to descend from a near-man on his way to complete humanity than from a degenerate Adam. Is it very certain that the man of Chapelle-aux-Saints was much less bestial than Pithecanthropus? Can we avoid regarding him as our ancestor? What a fuss over a mere question of degree!

The question is one which might have been important to men of the *ancien régime*, to whom fate was a matter of

birth. Should not development be paramount? It is well known that the Christianity of the Councils, pretending to be an extremely high stage of humanity (although it had somewhat deteriorated since the day of the Apostles), maintained that it had reached a degree of perfection not to be surpassed. Such was the futile claim of minds recognizing in motion only future immobility. There has been no race or period which did not believe it had attained final truth. Every succeeding generation suffered from simultaneous aspirations toward change and toward permanence. Evolution goes on within us, as everywhere. The problem is not so much to recognize the fact, since it constantly forces itself upon us, as to have the courage to adapt ourselves to it.

The gap between inorganic and organic evolution is not harder to bridge than is the gap between Providential deism and a cosmic dynamism from which all individualism is banished. Meanwhile, everything invites us to bridge it. For better or worse, we are obliged to answer the call of science. If the fate of our intelligence is in the balance, can we help watching the scales?

On the definiteness of individuality, increasing from the crystal or the cell to the most inclusive cerebration, we have all the threads needed to guide us. The mineral world, deceptively disguised, is no easier to analyze than is the apparently more mysterious animated world. However, when from the vantage-ground of our extinct planet we are amazed at the sun, at a star, or at a nebula, it is because they all present problems from which our phenomenology forbids us to dissociate ourselves.

Organic evolution is an open book to the man who will read it. Algæ, seaweeds, mosses, and ferns precede the phanerogamous plants, with their diversely flowering corollas. In lands chemically diverse there are successive formations of strata which preserve the remains of the animal series which in turn developed in them. The changes of form, the connection of which stands out sharply, constitute a graduated series of organizations increasingly com-

plex. Elementary forces carry on the course of the organic activities appropriate to the age of the sediment.

In cleansing the atmosphere of its surplus carbonic acid, the carboniferous forest determined the chemical composition of an air which the lungs of the higher vertebrates could endure. Every possible variety of species was developed, as is attested by the remains which, because of their scarcity, convey a wholly inadequate idea of an increase so extensive as to be quite beyond any proportions that we can grasp. Finally, there are the transitional stages in the life of the embryo.¹ They complete the striking demonstration of an identical origin through the irrefutable testimony of the identity of forms in the first stages of growth.

The evidence is strong, but inconclusive except in the field of biology, that is, in the late-coming organic phenomena doomed to disappear within the duration of the planetary cycle. Is it, then, conceivable that there should be in the Cosmos two different, and even contradictory, universes — one consisting of coördinated determinate changes, described as 'evolution,' and the other either consisting of movements irreconcilable with the orderly process just mentioned, or congealed into an incomprehensible and inconsistent immobility?

Since the coördination of cosmic movements is established beyond doubt, it follows that throughout the whole body of elementary activities, the forms of evolution in one field should be in harmony with the forms of evolution in other fields. How can it fail to follow that we must investigate the mineral world under the different aspects in which it happens to be presented to us, from the solar offshoot which has become an extinct planet to the sun-star which,

¹ At what moment does the soul enter into the organism which by some process unknown is destined to become its receptacle? The Church permits intra-uterine baptism, without being able to tell at what precise moment the soul may be considered as having appeared. When circumstances compel the surgeon to sacrifice either the mother or the infant, theologians, being logicians, have advised that the mother be sacrificed for the sake of increasing by one the number of good Christians. There are innumerable examples of that sort.

amid innumerable other stars, develops its activities in space in every form of sidereal evolution?

The study is forced upon us by spectrum analyses, which have already supplied striking testimony, not only of common underlying conditions, but of the seriation of energy. And since the temperature is an essential characteristic of the physico-chemical state of the astral mass, Sir Norman Lockyer seems to have been correct when he based his first generalizations — full of valuable suggestions — on the thermal types which succeed one another everywhere in the universe. In that field of phenomena, the advance of our scientific knowledge seems assured. At least, the coherency of our general conceptions is greatly increased.

Doubtless, the nebula has as yet done no more than grudgingly lift its outer veils, but it has had to render an accounting, for, by means of its pattern-points, we catch glimpses of an outline, traced by its evolutionary activities. Is that so small an achievement when we consider that until now no one has found any hypothesis with which to oppose it except that of an Almighty not mighty enough to create an ordered world? Long ago theology and metaphysics said all they had to say, and they can only repeat themselves. As opposed to that state of affairs, we have seen, and see every day, the wonderful penetrative power of our scientific investigations. Come forth, ye dealers in transcendental abstractions and show whatever in the way of knowledge verified by experience your flights of imagination have produced! We will oppose to you the marvelous picture, which every day grows more marvelous, of carefully tested research. The phenomenon of universal gravitation is in itself enough to reveal the sensitiveness of the reactions of the individual stars — a sensitiveness corroborated by the corresponding sensitiveness of the electrons in the atom.

The wonders of spectrum analysis have only begun. We have the right to cherish new aspirations. At present, there is no sign that our investigatory procedure is likely to become less fruitful. On the contrary, our analytical instruments daily become more efficient, and new methods of

procedure are discovered by which even our greatest geniuses are wonder-struck. While all our telescopes are incessantly leveled on the horizon as the advanced sentinels of knowledge, spying out the least sign of some variation which requires a new explanation, the universe in the established evolutions of its stars and of its atoms permits us to learn its secrets in the course of cycles in which the elements part only to rejoin in eternal successions of time and space.

The idea may appeal to us, or it may disturb our prejudices. Gravitation admittedly owes us no accounting, and we do owe an accounting to gravitation. Hurlled in the direction of Hercules, we shall reach no destination, for there is no stopping. We shall have traveled; we shall have passed by and through the windows of things; we shall have felt, seen, and known flashes of the infinite. Whatever we may be able to say or to do, that has been, that is, that will be, and will continue to be. At no point, at no moment, can the ardor of knowledge, which is the ardor of life, be brought to a stop, except through our dissolution — a dissolution imposed on us all and acquiesced in and even sought by some of us. For if we cannot prevent our birth, we alone in the universe have the power to interrupt the course of our destiny. At whatever hour we please we can bring to an end the course of our personal evolution, which, sometimes, is in too glaring discord with our emotional reactions.¹

Of course, our divine Providence advises against it, since we are its work, and since to approve our voluntary return to unconsciousness would be to condemn that work. However, suicide is an exhaustion of evolution, of which there are also other forms. How many unsuccessful lives are but

¹ Carried to the point of suicide — privilege of the man conscious of the exhaustion of his nervous power — individual evolution ends in a discord in the relations between himself and life, which leads to the voluntary dissociation of individual complexities. It would be curious to know at what point in his evolution man felt himself to be master of his fate. It was probably war which led the vanquished to turn his sword against himself. In this case, as in the case of all dynamisms, the last word remains with Fermat's law of least action, the scientific formula of the law of the strongest, identical with it, but inversely expressed.

a cowardly succession of connected acts of semi-suicide? To destroy others is generally less painful than to destroy ourselves. Any reading of the newspapers will prove the point. Dogmatic theology, which seldom concerns itself with the earthly inconsistencies of human life, consigns the suicide to hell and thinks no more of him. At the same time, as occasion dictates, it glorifies in its temples the massacres of war and its own acts of violence.

Rising step by step from the earth to Sirius and beyond, and so on *ad infinitum*, dazzled bearers of successive stages of consciousness which probably recur in other worlds, we pierce with our vain clamoring all space and all time and may occasionally be justified in doing so by the magnificence of the ideal we seek to attain.

For without in the least abating the value of knowledge, the thing which, within the unknown sum of subjective elevation to which our ideas raise us, is more important to the well-being of our lives is the emotional force which develops through individual and social adjustment. There is no human knowledge without its share of mis-knowledge. As we were born, as by our own efforts we have helped to form ourselves, we shall have played our part if in good faith we have striven; and we shall have acquired a just pride in ourselves if at the cost of some sacrifice we have been of some aid. When the end of our earth comes, the last choice will surely be to learn; the last gesture one of encouragement.

II

INORGANIC EVOLUTION

Reversing what the logic of the complex relations of the elements might have been supposed to require, the able works of Sir Norman Lockyer on inorganic evolution did not precede, but followed, the conclusive observations of Lamarck and of Darwin on organic evolution.

We began by labeling as 'known' a general system of imaginative misconception — and, after all, in an empirical

undertaking in which the only opportunity offered us was that of interpreting what seemed to be, we could have begun in no other way. That system, which was a mixture of thesis and hypothesis, was sure sooner or later to be the gate of scientific observation and the one method of helping us to understand.

Inevitably the premature label conferred singular advantages on authoritative fiction as compared to the frail fragments of scientific knowledge which appeared to be divergencies from accepted opinion. They became what were arrogantly called 'heresies.' 'I abjure the heresy that the world revolves,' Galileo was forced to say. Let that odious sentence remain in our memories as a supreme lesson. What an accumulation of fruitful labor ended in that sensational apostasy! Pages in the book of human achievement, and, moreover, the most significant pages, were unhesitatingly torn out because dogmatism (which knows nothing), claimed the right to lay down the law for the human mind.¹

How many geniuses had put their stamp upon the centuries before any one of them took note of the signs of organic concatenation to the point of drawing from those signs that view of elemental development which, under the name of 'evolution,' even to-day shocks ignorance! Who, then, could be expected to pay serious attention to an inorganic evolution, the evidence of which is much less clear than that of organic evolution, and which, moreover, would have led us into the paths of a universal transformism, still more disconcerting to our firm belief in metaphysical fixity?

Sir Norman Lockyer devoted himself to the spectrum analysis of the states of matter that succeed one another in the sun and in the stars, with the idea of arriving at suggestive comparisons between them and the similar planetary

¹ The reader may have observed that I systematically disregard all metaphysics based on 'logic.' Not that there are no laws of ratiocination. But the danger from a badly constructed syllogism is much less than from an imperfectly observed phenomenon.

phenomena of which our earth is the result. This important branch of our modern knowledge has already attained such development that when any experimental aspect of terrestrial activities occurs, the mind turns to those eventual corresponding activities in the stars which offer decisive evidence of the universal coördination of the elements.

As a matter of fact, the spectroscope has enabled us to enter into the physical and chemical activities of the stars, in which scientists have recognized degrees of 'dissociation' in the elements which correspond to the degrees of temperature. They are, says Lockyer, phenomena of 'evolution.' This idea, borrowed from the theory of 'organic evolution,' is put forward in order to describe in all its stages the action of matter, absurdly called 'inanimate.' It seems impossible to reply by a flat denial when we see inorganic activity, closely connected with organic activity, reconciled with it through harmonies of form and of structure to which we must attach weight if we are not to renounce observation altogether. How can it be possible that every cosmic activity is not precisely congruent with the activity which precedes it and with the activity which follows it, — always along the line of least resistance, — thus producing the effect of direction? Is it conceivable that the law of evolution applies only to that part of the universe which is out of harmony with those other parts which cannot be adjusted to it? Since the universe consists exclusively of motion, how can it be exempt from the law which governs all its elements? Such a condition of things would be chaos. Of course, the unity of the cosmic substratum and of its action is established throughout the immense range of our most far-reaching vision. Elements manifest themselves, and relationships are distributed, in identical ways, as far as we can see and doubtless beyond.

Because we are human, we have been able to grasp only passing fragments of the cosmic chain. Our business is to live in harmony with our knowledge, according to the conditions of the Cosmos, and not to speak and act according

to conventions such as were established hap-hazard by our ancestors' limited mental resources.

Marked progress has been made when a man like Lockyer scientifically states the problem of 'inorganic' evolution. The term 'mineral evolution' would, I own, have seemed to me more apt, since the word 'inorganic' is merely negative and is all the more inadequate since organization, that is, the interdependence of the parts of complex bodies, is a word in common use. However, let us take words as we find them.

In the sun and in the stars, at extreme temperatures, study of the spectrum reveals to us coördinate elemental action in which Lockyer sees a 'dissociation' that he regards as a phenomenon of 'inorganic evolution.' It cannot be denied that here, at the very start, we are plunged into the unknown. Hints that we can glean suggest a preliminary analysis. Synthesis is at present beyond us. The law of mental processes requires that progress consist of constant revisions. An evolution which 'dissociates,' that is, rarefies the substratum at extreme temperatures, calls for an evolution which reassociates it, that is, condenses it by cooling. That suggests a cycle running from the highest temperature to the lowest which, through the collisions of the stars, itself returns to the thermic maximum from which radiation will bring it back to maximum cold.

To define the problem, Lockyer finds himself obliged to connect it with the conception of organic evolution, 'the most complete revolution in modern thought which the world has ever seen.' 'As a matter of fact,' he writes, 'organic evolution can be defined as the production of new organic forms from other more or less varying forms, with the result that through the instrumentality of a long series of separate, or simultaneous, modifications, present plants and animals are the descendants of a limited number of much simpler primitive types.' Transferring the discussion to the chemical elements, he calls attention first of all to the differences in composition revealed when we study stars of successively higher temperature. In the organic world varia-

tion depends on time, and in the inorganic world on temperature.¹

Since evolution proceeds from the simple to the complex, we should first seek the forms of the inorganic world in those regions where the temperatures are actually the highest, and where, consequently, the ultimate degree of simplification exists. 'The final product of dissociation, or separation by heat, should therefore be the primary chemical form.'² We do not know what the highest temperature may be, or to what states of matter the term may correspond. Is there a progressive series of new forms comparable to geological strata, running from the most ancient to the newest, between the hottest and the coldest stars?

'In cosmic evolution,' says Lockyer, 'we have observed a continuous succession of effects accompanied by marked changes of temperature. . . . As we pass downward from the hottest to the coldest stars, the number of lines in the spectrum increases, and with the number of lines, the number of chemical elements. . . . The salient features of organic history are thus so exactly reproduced that the best way to represent the results is to designate the different stellar periods by the chemical form which they take, and which are revealed to us in exactly the same way as organic forms are revealed to geologists. The explanation of stellar strata is exactly the same as the explanation of geological strata. Between the hottest and the coldest stars I have found ten groups so chemically distinct from one another that it is necessary to distinguish among them as clearly as we distinguish between the Cambrian and the Silurian strata.'³ Any one can see that this question: 'Do the stars show progressive chemical forms analogous to the progressive forms in the geological strata?' admits of a clear and precise reply.

¹ I merely transcribe the formula of the author. Obviously neither time nor temperature can be eliminated from the phenomenology of evolution.

² 'Previous' is more correct than 'primary' since the universe is no more than a succession.

³ Lockyer has actually distinguished, classified, and named ten of those groups.

They do show such progressive forms. Therefore, we have the right to consider matters from the novel point of view of evolution. The problem is clearly stated.

The simplest chemical forms occur in the hottest stars, and they increase in complexity with the lowering of the temperature. Such may be supposed to be the fundamental formula of inorganic evolution, as it is of organic evolution itself — at least until some yet unknown problem arises. We must recognize that studies based on spectrum analysis are extremely difficult, because of our imperfect knowledge of elemental states. In that field, even though many interesting discoveries have been made, science is still groping its way. We can advance only step by step, and boldness should be tempered with caution.

Lockyer completes his 'stellar proofs' with his 'solar proof.' We can only formally acknowledge what he has done without as yet discounting the conclusions of the future. We have only arrived at the preliminaries of an hypothesis, and the greater its value, the more circumspect should we be in accepting it. It seems to me certain that Lockyer has opened a broad road of new knowledge which we should resolutely follow in making future experiments. The future will pass judgment on his original interpretations. Whatever the outcome, the glory of having formulated an interesting theory of the universal evolution of the perpetually changing Cosmos will remain his.

'Stratigraphic geology,' Huxley has said, 'is only the anatomy of the earth. The layers of sediment, with their vestiges of flora and fauna, give clear evidence; yet many ages passed before any one interpreted the marks which unrolled before our eyes the authentic history of our planet and of its inhabitants. Only in our own times did men make up their minds to undertake the task, and with the earliest observation such palpable proofs of organic evolution came to light that the great name of Cuvier and the authority of academies saw their ephemeral victory over Geoffroy Saint-Hilaire followed by a general rout of the famous

theory of separate creations.' ¹ After Lamarck, Darwin had the great honor of bearing the brunt of the battle, and people soon forgot the burning question of whether we originated from Jahveh, as Moses declared, or from the mother planet, by way of some nameless Pithecanthropus.

The succession of forms in the animal life of Archæan or primary strata clearly indicates the progress of organisms from the simplest to the most complex, in series of periodically rearranged hierarchies. Are they mere coincidences, or are they links which reveal organic filiation? The answer is obvious.

It is common knowledge that in the first sediments the sequence begins with the invertebrates, sponges, corals, molluscs, and trilobites, together with the débris of vegetation. In the succeeding sediment is found the further development of those first forms. Indeed, as we mount toward the surface, we meet giant crustacea, sea-animals with shells, but without a lower jaw and without fins, and fish with defensive armor. Later, in the higher strata, we find the first animals breathing air, fishes, the first vestiges of vertebrates, flying fish, and scorpions. Amphibians occur in the Carboniferous strata. In the strata above are found reptiles, among them the theriodontes, which have the dentition of the deer (incisors, canines, molars), the ornithorhynchus and the echidna (two oviparous mammals), winged reptiles (pterodactyls), birds, anthropoids, and the pithecanthropes, — the quaternary man who may perhaps have occurred earlier and who unquestionably was the forerunner of actual man.

In the latest strata, all the variations, all the complexities, are present. Trilobites are very abundant in recent formations, and the annelids and brachiopods persist. Worms existed. Certain fishes disappeared as the result of new conditions and environment; others survived until our times. The existence of a continuous evolutionary life, con-

¹ 'There are,' says Linnæus, 'as many different species as there were distinct forms created at the beginning by the Almighty.' That was the doctrine which Cuvier adopted, and which he ultimately disproved.

firmed by the decisive testimony of embryology, is everywhere apparent. At a certain point we find a remarkable similarity among the embryos of the tortoise, the bird, the dog, and man. What explanation is possible other than that there is a definite line of development and an undeniable organic kinship. I am obliged briefly to state these established facts, to which I shall come back later, because from them came our first theories of a continuous evolution, the authentic evidence of which forced itself upon us.

Is there in the inorganic world an analogous succession of developments? Can we, should we, recognize in the chemical elements the product of a like evolution? Vegetables and animals evolved in temperatures which on the average have been much the same down to our day. That cannot be true of the chemical elements, which show changes in composition proportionate to the temperature in the stars in which we study them. 'The differences,' Lockyer repeats,¹ 'in the organic world depend on time, and in the inorganic world, on temperature.' As we go up in the scale of temperature, we meet the oldest forms, and, consequently, the simplest. We can see that heat dissociates chemical compounds. Whence we conclude that oxygen and iron must have existed in the stars before rust.²

Whether there be, as scientists affirm, a 'final product,' is something which for the present experiment cannot establish. How can we conclude that since we cannot observe anything beyond a certain degree of temperature, there exists no degree in excess of it? What can we know of the ultimate quality of any chemical phenomenon? We observe that a rise in temperature results in a new degree of dissociation. The 'final product' is found to be 'final' only within the limits set by the inadequacy of our means of analysis.

With that proviso, it is of capital importance to recognize

¹ *Inorganic Evolution.*

² To tell the truth, this view is purely subjective, since we cannot say whether heat or cold 'came first' — a phrase which, cosmically speaking, is meaningless.

that if in the past as well as in the present, and amid the general activity of the universe, it is time which conditions organic evolution, it is temperature which, so far as our observation can determine, governs the phenomena of inorganic evolution. 'Therefore,' Lockyer concludes, 'if the different stars are like the different geological strata in respect 'to providing us with a series of new forms in ordered sequence,' we can regard the chemical substances which visibly exist in the hottest stars as representing the oldest forms.' We must obviously resort to the stars for that observation, since they offer us temperatures higher than those we can create in our laboratories.

It seems incontestable that between the hottest and the coldest stars there is a progressive series of new forms similar to that between the oldest and the youngest geological strata. Taking the stars in the different phases of their evolutionary activity, we have classified them according to a curve of temperature which descends to the chill of the moon, of the earth or of the satellite of Sirius. That is, indeed, an extensive linking up of chemical phenomena.

I do not propose to elaborate on spectroscopic descriptions. I shall merely note results. In the hottest stars only a very small number of chemical elements have been identified. As we go from the hottest to the coldest, the number of chemical elements constantly increases; we discover substances which are known, or which are yet to be identified, some of which have been found on our planet, but only at a later date.

At the highest temperatures we find hydrogen, for example, and some other elements under forms which do not occur in our system. As we follow the progress of cooling, we find new elements in forms which the highest temperatures of our laboratories can reproduce. How can one avoid the conclusion that those forms are produced by the lowering of the temperature? At each stage, as new forms appear, old forms disappear. Lockyer did not hesitate to institute cosmological records in which the different stages of the

stars are designated according to the chemical forms which appear in them, just as geologists do in the case of organic forms.

It is important to note that the simplest elements appear first. But are chemical compounds increasingly complex in proportion to the fall in the temperature? There is a more extensive series of such complex compounds in the case of some substances than in others — a fact which somewhat alters the picture. 'We have,' says Lockyer, 'none the less proof of an evolution truly majestic in its simplicity.' I shall not dispute it.

Whether or not hydrogen is the radical of all substances, we are led to believe that the elements analyzed in our laboratories are no more the objects of particular creation than were the species, as Cuvier defined them. With the lowering of the temperature, which induces chemical reactions of every kind, there are created complexes of compounded energies — as plants and animals attest.

Hence it is not surprising that Lockyer should have declared that life, 'admitted to be the result of an evolution,'¹ has in a sense been an appendix to the work of an inorganic evolution, accomplished in a wholly different way.'² Let us even say an inevitable appendix to 'inorganic evolution.' In this case there seems to be but a single general evolution which combines the two forms of evolution — the organic and the inorganic.

If it is definitely proved that the different luminous spectra are produced, not by different substances, but by elements of the same substance dissociated at astral temperatures, we shall have attained an important point of departure. It will even be a decisive step toward the conception of a unit of substance, answering to a unit of energy, which would represent the identity of the dynamisms of the universe within the cycle of universal transformism.

¹ According to Lockyer, life began at a temperature of from forty to fifty degrees centigrade.

² Again, this remark indicates nothing more than our present ignorance of the conditions in which both organic and inorganic evolution takes form.

ORGANIC EVOLUTION

As we have seen, the question of organic evolution could not arise immediately upon the discovery of the imprints left by the phenomenon of life, in regard to which our first care was to emphasize remote differentiations. The formidable empirical problems of the universe pressed upon us too insistently for us to pause when we caught gleams of generalization — gleams summarily extinguished by the first prejudices of theological emotionalism, which too often took, and which still too often takes, the place of philosophy. Think of the effort necessary if, without the support of continuous experiment, we were to break with the traditional thoughts which from primitive times to the present have not ceased atavistically to echo and reëcho in our minds.

Too long have we been pleased to seek in animal intelligence a reduced scale of human intelligence — a sort of contraction of the animal to the point required by our dominating power, whereas it was the irresistible impulsion of rising life which launched us on the conquest of the world, in the course of an ascent from organic depths to the summits of knowledge. It was the confusion of minds muddled by atavism; minds quite willing to stand on mountain tops, but unwilling to admit that they had risen from the valleys!

It took the discoveries of paleontology to make us realize that a history of animal life could be put together from authentic exhibits collected in our museums. And so thoroughly lodged in our minds was the presumption that the human race represented a break in the chain of organisms, the close resemblances among which are everywhere patent, that we see Cuvier himself, the founder of the new science, try to escape with the aid of an imaginary 'separate creation' from the conclusions which his own labors had scientifically established. There is no more striking example of the diverse ways in which the human mind goes astray than the simultaneous presence in the same intellect of a noble gift of scientific observation and of the hereditary

inertia, imposed by primitive fears, in the presence of the most authentically corroborated observation.

The whole drama of man in his struggle against himself moves us more each day, because what is at stake is nothing less than the intellectual effort which seeks a synthesis of the general phenomenology of the universe. The execution of Socrates was like a preliminary skirmish; the condemnation of Galileo like a hard fight at close quarters. The irreparable defeat of Cuvier at the very peak of his great victory marked the day when the generalizations of the scientific mind definitely got the upper hand. It is true that the last strongholds of theology and of metaphysics still hold out, but they are so closely besieged that in spite of subsisting acts of violence surrender is in sight.

It is time for those who do not stay behind in order to engage in rearguard skirmishes to perceive that the principal obstacle to our correct knowledge of the action of the universe comes from the habit, into which we are forced by heredity, of resolving at the start all cosmic problems before we can consider them objectively within the limits of the actual succession of phenomena by means of realized abstractions. We set it up as a law that all activities of the universe are like our own, the result of sensibility and of will. And when the idea of coördination occurs to us, what formula could be simpler than the fiction of a personified divinity, no more explicable than the universe itself, but affording the apparent stability of a word to which we can steadfastly cling? It is a simple transposition of those terms in which we describe the connection between the world relationships and our receptive nerve centers.

The same thing happens in the case of the general formula for the phenomenon called 'life.' We think we have accomplished a great feat of understanding when we group under that abstract word without objective reality the phenomenal relationships which characterize the organic world. The question is answered by a question. It is a repetition of the question; it is not an explanation.

'Modern science rests on laws; that is, on relations. Now,

a relation is nothing more than a connection which mind establishes between two or more terms. No relation exists independently of the attributing intelligence.¹ The universe, then, can be a system of laws only if the phenomena pass through the filter of intelligence.' In these terms Bergson, in his '*Évolution créatrice*,' undertakes to salvage those remnants of metaphysics which might still be misleading. With that purpose he resolutely tries to jettison all his metaphysical baggage. He almost gives up finality. If he accepts evolution, he does so only after distorting it by his transcendental 'creative evolution.'

But how can he say that intelligence 'relates'; that is, establishes relations? Intelligence RECOGNIZES what it finds already established. Bergson would not maintain, for example, that, should all intelligence disappear, oxygen and hydrogen would no longer combine to make water. I do not dare attribute such an idea to him, for, deprived of biological phenomena, the stars could show us nothing except unrelated elements. Let us, then, allow the universe and sensibility each to perform its own rôle, one displaying its evolutions, the other showing the special effect of a special evolution which reflects parts of the whole instead of determining them.

Bergson divides his criticism between the mechanistic conception of a universe governed by immutable laws and the thesis of a preconceived design implying finality—that is, the reversal of the relations between the cause and the resulting phenomenon—for the purpose of setting up his own creative evolution, in accordance with which the universe, undergoing incessant creation, eludes all foreknowledge of cosmic action as well as the institution of a preconceived plan.² He expends all that ingenuity in an effort toward the transcendental no more and no less valuable than all other similar efforts. This is because in it the words 'vital prin-

¹ How can the relation between the antecedent and the consequent be the effect of the sensibility, the only function of which is to reflect it?

² To be created through evolution is to continue, but no one knows how, since the idea of creation suppresses all necessary connection among phenomena.

ciple' and 'vital urge' become, through some great marvel, the denominators of an undetermined creative power.

Of all the authors invoked by Bergson I set down only this quotation from Huxley, and that because of its extreme simplicity: 'If the fundamental proposition of evolution is true, namely, that the entire world, animate and inanimate, is the result of mutual interaction in accordance with the definite laws of the forces of the molecules which composed the primitive nebulousity of the universe, then it is no less certain that the present world rested potentially in the cosmic vapor, and that an adequate intelligence, knowing the properties of the molecules of that vapor, would, for example, have been able to predict the state of the fauna of Great Britain in 1848 with as much confidence as a man feels when he describes what will happen to the vapor we breathe on a brisk winter's morning.' Nothing could be truer. To encompass the absolute we need only absolute intelligence.

Until some one tells us what experiment will disprove a mechanistic view of the universe, a view confirmed at every point by experimentation, we insist on greater certainty than mere metaphysical variations on a theme transposed from the creative power of Jahveh to the creative power of evolution. 'A caption over our ignorance,' modestly alleges Bergson. But of what use is a caption which conveys no information?

Bergson is just as bitter against the finalism of Leibnitz, who alleges, only too soundly, that the idea of a preconceived plan is a wholly unproved intellectual theory. But Leibnitz is no sooner put to rout than the same Bergson who laid him low hastens to pick him up, announcing that 'to a certain extent' his own thesis 'is finalistic.' His is a finalism of the second degree which, having been excluded from cosmic evolution, reappears in organic evolution. No one could more gracefully straddle a fence. That is because 'reality' seems to us an uninterrupted stream of novelty which creates the world outside the range of any possible prevision, but which, nevertheless, remains, no one knows how, in some transcendent sense final.

However, the thesis of finalism is definitely disproved the moment the formulæ of evolution are made precise.¹ Does the bird fly because it has wings, or has a certain X, unknown to us, given it wings, because it has previously conceived the idea of making a flying machine? Men have struggled with that problem, although it consists in asking whether the Cosmos may not have borrowed from our human relativity the processes of its universal action. We have needs, and in order to satisfy them, we conceive plans to which we try to adapt such means of realization as are ours — not, however, without a great amount of readjustment. The universe shows no previous plan, nor does the Creator.² Is it not insulting him to suppose that, like an artisan, he is obliged to try out plans, with the idea of sticking to them while, with more or less success and at the risk of a too faulty approximation, he harmonizes them with the whole?

As to the general objectivity of the universe, the dominance of which is undeniable, it is wholly evolutionary, wholly made up of determinate motion, governed by the unknown law of the 'future' which lets our ingenuous relativity seek the illusion of design, like the designs of humanity, in what is the result of unbreakable relationships. For if we are to detect an anterior intuition in the Cosmos,

¹ 'If we consider an eye such as ours, in which a thousand elements are brought to a coördinate unity of function, everything about it seems marvelous. But we must consider the function at its beginning in the infusoria, where it is reduced to the almost purely chemical sensitiveness of a smudge of pigment to light. That function, which, at the start, was nothing but an accidental fact, was, whether directly through some unknown mechanism or indirectly through the single circumstance of its being advantageous to the living creature and to the hold it thus gave to natural selection, able to bring about a somewhat increased complexity in the organ, which may be supposed to have brought about a perfecting of the function.' (Bergson, *Évolution créatrice*.) I quote this passage to show the concessions which the author makes to transformism. From our present point of view, it is enough to eliminate from them the word 'accidental.'

• The notion of a previous plan is the induction of metaphysical minds made before man had recourse to knowledge drawn from observation. It might be said that the universe has 'needs' like ourselves, since it is wholly made up of movements in quest of a shifting equilibrium which must be stabilized.

we must first of all make it human, that is, degrade it to the level of our relative minds. Such a course is excusable in the simple-minded savage. It is time for our deterministic philosophy with its postulate of coördinated energy to save us from such puerility.

It took centuries for the idea to seep into our minds of first of all considering the ascending scale of living creatures in the conditions in which they successively appeared and then of including ourselves in the evolutionary progress of that series. What battles were caused by the suggestion of kinship! How much simpler, and for that reason how much more attractive, it was, for the sake of divorcing man from the orderly development of which he is the result, to welcome an ultimate generalization with no other foundation than words. It was a man-made mystery to which a magic password was to admit us! According to that view, life was life, that is, an entity made of no one knew what; it was the vital urge, fit to solve every problem of biology by the mere use of the word 'creator.' And, indeed, if we attack the problem in reversed genealogical order, when the whole history of the animal series show it evolving from the depths, we find ourselves caught in a merely verbal synthesis which offers to analysis nothing but the negation of a mere sound. We are left with nothing but the eternal repetition of the tautologies which are the beginning and the end of an inveterate metaphysics.

As the distance between the individuals of the animal series gradually decreased, the metaphysical mind at first denied the existence of any actual series. 'Freaks of nature,' jokes of cheap scribblers, interdictions by academies — such was the line of defense. Then when it was admitted that the sequence did exist, all interrelation was denied. It was asserted that individual specimens were only isolated bits 'which were only supposed to be connected,' and which might be the result of inherited variations due to differences of structure and of environment.

Once the battle had begun, Lamarck, Geoffroy Saint-Hilaire, and Darwin took command of the vanguard. The

word 'life' contains no secret other than that of an abstract representation of abstract characteristics on which a classification of coördinate phenomena is based. Let us make the effort of regarding these phenomena simply in their historical order, as we are obliged to do in the case of the majority of human records. And as we see civilization emerge from savagery, so we see complex organisms (and consequently complex functions) develop out of the original simplicity of dynamic cycles, — a simplicity that is itself complex in comparison with what preceded it, — parts of which can be, and which already are, determined.

Organic evolution is obvious; we are obliged to recognize it, if only because of the concatenation of the successive forces of phenomenology. Amid the storm, the great veil of the metaphysical temple was irreparably rent. Light pierced the gloom. The great mystery turned out to be one which with much difficulty we had ourselves created.

Considering man in a static state as an anatomical specimen on exhibition in a museum only raises possibilities. The function of the organ becomes manifest only in the course of those activities which in their ordered program constitute the phenomena of evolution. That we should have begun by worshiping the miraculous, that is, by abasing ourselves before the unknown, is only too easy to understand. The first empirical forms of scientific knowledge slowly prepared the way for the sweeping inferences of Lamarck and Darwin. Before long we had gathered and coördinated sufficient data to support conclusions based on experimental observation. The choice lay between Moses and Darwin, between divine creation and a strict coördination of organic activities rooted in an inorganic evolution with which it had to merge.

The most theological of theologians will concede that unbreakable bonds exist between the phenomena of organic life at every stage of the animal series — man included. What were these bonds? As disciples of Moses, thinkers of the olden times could see in them only the thwarted purpose of an eternal will which, after numberless eternities, might

be supposed suddenly to have ceased to be self-sufficient in its efforts to create a terrestrial dependency. To adduce the incomprehensible as a proof of comprehension is childish. On the other hand, the organs of animal life — plasmas, figurate elements, tissues arranged in multiple, concordant series — necessarily suggest generalizations based on comparisons between all varieties of organization.

We have before us the whole animal world. Our first effort at knowledge consists of a classification of such and such outstanding and definite characteristics. Our classifications are instinctive, because comparisons imply a more or less thorough understanding. And, indeed, that is the goal at which we must aim if we are to grasp relationships.

We classify according to more or less obvious resemblances, and we are quick to deduce therefrom hap-hazard comparisons or distinctions. From that point on, we are thinking, we are working toward new conclusions. Fate must run its course. Observation has disclosed similarities and differences. Our intelligence has become aware of them. It will concentrate on the search for common relationships, which sooner or later will suggest logical hypotheses as to their sequences.

After we have observed, after we have classified, we shall interpret the relationships. It is a double field in which both strict experiment and free conjecture operate at each other's expense, according to the luck of the moment. Everywhere and always there is a conflict between scientific knowledge and imagination. These phenomena, together with various opportunities for every kind and degree of emotion, form our history.

If our criterion were single, our records would be simplified. Organic adhesion to ancestral misconception, together with the resulting inferences, protects us on that side. That is why, until modern times, our classifications of the organic world suggested only sterile comparisons. Scientific knowledge had to yield to the pressure of the primitive conclusions which sought to rule it in spite of the evidence of

contradictory experiment. Centuries of human thought have not yet succeeded in freeing us from that atavism.

In spite of bitter opposition, our classifications of the living world are to-day recognized in the interpretation of proved relationships. The great discovery of modern times is that of a series of organic forms in which, under the veil of a transformism shocking to our newly acquired susceptibilities, we find the titles of nobility of the human race. We have won such a firm position in the far-flung battle of science against imaginative dogma that from now on there can be no question of ordering the hangman to burn the works of Lamarck and of Darwin, as was the fate of 'Émile.'¹ They will not even be condemned by the Faculty, as was Buffon's 'Histoire naturelle.' We live in an age of science, and it is time we recognized the fact.

If science consists in classifying all cosmic activities with a view to making those comparisons which will explain our knowledge of phenomena, how can we refuse to study organic life along the same lines? To date, no other scientific explanation of organic evolution has been adduced in opposition to the doctrine of evolution. The consequence is that, as I have said, we must choose between Moses and Darwin. Now, if, with good reason, the Bible says nothing of physics or of chemistry, why should it mention biology? All sacred books are valuable landmarks in the history of human thought. Their teaching was based on spontaneous misconceptions which in time were bound to be rectified by a more or less slowly growing knowledge which, like a flickering light, constantly becoming stronger and steadier, finally enlightened the obscurity in which man lived.

However, out of those confused glimmerings which are

¹ There remains the amusing incident, which occurred at Dayton (Tennessee), when, without daring flatly to condemn the doctrine of evolution, a court, obliged to admit its ignorance, enforced a State law, prohibiting the teaching of the doctrine in the schools. This would seem to prove that man has not changed so much as he appears to have done since the days of the Inquisition. By great good fortune private schools will safeguard the freedom of knowledge. In fact, California offers a professorial chair from which the Tennessean convict may hold forth.

our mental inheritance there developed a compensated total of mingled dreams and knowledge. It constitutes the common foundation of ordinary 'good sense,' which, half-way between fiction and experience, served to balance imperfectly verified opinions. 'The man in the street,' who is a matter of concern to other nations beside Great Britain, may have no real opinion on any problem—which will not prevent him from passing on as final and decisive any information he has chanced to gather from people no better informed than he. Would any one ask us to halt at a form of ignorance represented by *a priori* 'assent'? We observe in order to learn, and when the classification of phenomena leads us to suggestive comparisons, people cannot prevent our making further search by saying that those comparisons are contrary to the 'authority' of preconceived ideas.

Shall we classify man in the animal series, or shall we set him apart? We must accept the necessity of deciding. The Bible makes an anomaly of us by putting us halfway between earth and heaven and then leaving to us the task of finding an impossible reconciliation between an unexplained beginning and the inexplicable lack of any end. The conformity of the organs in the series of mammals, including man, peremptorily puts an end to any attempt to separate the higher organisms from the graduated lower forms. There is less difference between *Pithecanthropus* (who had no soul) and the man of Chapelle-aux-Saints, (who may have had one) than there is between the *amoeba* and the flying-fish. The distinctive identifications of morphology, if they have any real significance, should necessarily retain that significance at every stage in the series. Pleasing or displeasing to the doctrinaires of continued misconception, the way in which observed phenomena are linked together proves such affiliation.

Transformism is the result of the functioning of paleontological relationships. Vegetable species preceded animal species. The fact is proved by the fossils of the primary strata, in which no trace of animal life is found, and, indeed, animal life could not have existed in the atmosphere of

those ages. Slowly we can see the whole chain of organisms fall into order, — species, genera, families, orders, classes, divisions, — and there is no sign of any flaw in the foundations.

Should we discover in this hierarchy without beginning or end any scientific significance, or is it only an amusing mental gymnastic? If there is no justification for these innumerable relationships; if they are no more than accidental juxtapositions which cannot be accounted for by any interpretative process, — a mere deception where there is no need to deceive, — then it is not only the species, genera, etc., which must be separated one from another. In that case the entire order of nature will have to be reduced, piece by piece, to a powder of disconnected particles. The universe, made of independent elements, would then no longer be anything except a haphazard chaos, with no relations to interpret. For that very reason all attempts to know would cease to have any justification, for there could be no object in penetrating unsystematized relations, in an effort to find a systematic order. The world must be composed of coördinate relations, otherwise the coherent universe vanishes. There must be relations of generation, of filiation, and of evolution — or there must be nothingness. Do people understand why metaphysics and theology are often obliged to deny evolution, without trying to substitute for it any scientific explanation of those interdependencies of life which force themselves on our intelligence? If there is no evolution, there could not be, as Cuvier maintained, anything except an abrupt and fragmentary creation. An inconsistent God, creating the universe in order to display his contradictory personality, would have committed the imprudence of not harmonizing the manifestations of his will.¹

TRANSFORMISM; LAMARCK; DARWIN

After classifying the organic world in intellectual categories which reveal its richly suggestive relationships, the

¹ The latest effort of the new metaphysics consists in accepting evolution in order to distort it. Professional sport; academic fencing!

law of evolutionary causation, when sought and followed, placed us in the presence of a glorious new world. That was the great revolution led by Lamarck,¹ and Darwin — more important to thinking humanity than any war or peace.

'Although nature,' writes Buffon (1778), 'shows herself constantly the same, she nevertheless moves in a continuous round of successive changes, of perceptible alterations. She makes new combinations, new mutations both of matter and of form, and to-day is different from what she was at the beginning and from what she became in the course of time.' With that statement Cuvier refused to agree, for he would not admit that 'modern peoples are modifications of ancient types still often seen.'² As Geoffroy Saint-Hilaire points out, Cuvier thus destroys the unity of the coördinations of the universe which Buffon recognized, and before which, after a violent struggle, the school of Buffon had to bow.

The high philosophic inspiration of Goethe's numerous works on natural history is to-day fully recognized. He dared resolutely to align himself against the sacrosanct theory of final causes; he promulgated the theory of 'the action of circumambient modifiers on the organism, from which results its inner perfection, and its harmony with the subjective universe which its exterior exhibits' (1795). This remark is comparable to the famous dictum of Montaigne: 'All things are in perpetual flux³ of change and variation.' As early as 1791 Goethe began to wonder whether the cranial dome were not the result of the transformation of the cervical vertebræ, brought about by the thrust of the encephalus. In 1786 Goethe and Vicq d'Azyr simultaneously recognized that the intermaxillary bone, long known to exist in the ape, also existed in man.

¹ Lamarck was the founder of invertebrate, as Cuvier was the founder of vertebrate, paleontology.

² Geoffroy Saint-Hilaire, *Études sur Buffon*, 1838.

³ This remark was later taken up by Newton, who considered every finished quantity as having been engendered by a flux of the infinite. From the point to the line, from the line to the plane, and from the plane to the solid, our subjectivity retraces the sources of individual formation.

We can understand the deep interest which Goethe took in the great debate between Cuvier and Saint-Hilaire. Eckermann relates that at the end of July, 1830, as he entered Goethe's room in the morning, Goethe jumped up and exclaimed:

'Well, it's broken out!'

'Yes,' replied Eckermann, 'the revolution is accomplished. Charles X is in flight.'

'I'm not talking about that,' responded Goethe; 'I'm talking about the debate between Cuvier and Saint-Hilaire at the Academy.'

It was Lamarck, a man of silent but unshakable courage, who lifted the last veil and gave us a genuine view of a too long misrepresented world. He died poor, blind, forgotten, and disdained; he was not even scorned. He had had his day. I cannot see that any of our most famous scientists had greater ability than he. How are we to analyze the complex forces which lift a man above average greatness? Fickle posterity proclaims some 'geniuses' as greater than others. The history of men who have hastily been hailed as 'geniuses,' but whose vogue soon passed, is very pathetic. The surest foundation of intellectual eminence seems to be hard work which can stand the test of time. How can the fact affect the popular 'leaders,' constantly wrangling among themselves over alluring, but fallacious, expectations, or over scraps of evanescent ideals which they always have to give up?

Lamarck was one of the happy few who disregarded such considerations. He was a born investigator, and, living in a halo of luminous thought, could be neither encouraged nor discouraged by any one or any thing. The answer must be that his enormous labor did not really interest any one; otherwise he could not have been so completely forgotten that Darwin, after making innumerable observations which he patiently arranged in logical sequence, did not so much as mention the name of his predecessor and again resumed the great work, already reinforced with powerful buttresses. He based the doctrine of evolution less on the inheritance of

acquired characteristics (following Lamarck's own theory) than on natural selection in the struggle for life, whereas Lamarck laid more stress on variation due to habit,¹ and even to environment. As a matter of fact, Darwin only followed the broad path obscurely but gloriously staked out by the laborious efforts of the great man who had preceded him. To Lamarck belongs the undying glory of having made the great generalization; to Darwin belongs the credit of having gathered a vast quantity of corroborative facts. The two names will never be separated.

To carry on the investigations of the masters, their disciples have started and have pursued laborious inquiries into the successive development of the transformations and of mutations in which experimental analysis found its opportunity. When the general theory had been hypothetically determined, there followed an investigation into all the questions which it provoked. Between the neo-Lamarckians and the neo-Darwinians, the discussion may last long. Since the competition of organisms, when carried to a conclusion, results in organisms of different degrees of development, and since that development is dependent on correlated changes which succeed one another along the line of least resistance, which is the final determinant, numberless problems concerning the conjunctions of energy and of how those conjoined forces act, afford opportunity for every kind of attempt to determine them scientifically. At present, the two schools, trying to reconnoiter the vast field of explanatory formulæ to which the law of evolution, so long unrecognized, has called their attention, are fighting each other bitterly. For the moment I can disregard them. I shall not attack the problems of to-morrow. Here I con-

¹ It is rather remarkable to find in Pascal a precursor of Lamarck. We know that the unity, the ever-varying identity of the Ego, was a serious philosophical problem until the discovery of evolution. 'What is this personality which can be effaced?' And, having asked the question, the perplexed thinker answered thus: 'Custom is a second personality which destroys the first.' Clearly, it is identical with Lamarck's 'habit.' And, indeed, the exercise, the use, the training, of the function, developing organic activity into other succeeding activities, implies the new form of activity which is to spring from the disappearing form. Admit progress, and you cannot deny evolution.

fine myself to the work of Lamarck himself; it is an ample field.

In his '*Philosophie zoologique*,' Lamarck boldly formulated the cogent synthesis, embodied in the doctrine of sequential relation, of lineage of descent, — or evolution, in a word, — which he developed into a scientifically established synthesis.

He says: 'The systematic divisions — classes, orders, and families, together with their names — are the purely artificial work of man. Species are not all contemporary: they descended from one another. . . . Diverse conditions of life have a modifying influence on the "organization," the general form, of the organs of the animal. . . . Geological evolution of the world and the peopling of it with organic beings went on continuously. Life is merely a physical phenomenon. All the living, or organic, bodies of nature are subject to the same laws as the lifeless, or inorganic, bodies. Ideas and all other manifestations of mentality reside in the central nervous system. Actually, the will is never free. Reason is merely a higher degree of the development and comparison of opinions.'

Thus, from the outset, this scientist in a work the mere title of which proclaimed an intellectual revolution courageously planned, outlined the conception of a determinate world. Why should any one accept it? The most important event in modern thought was doomed to pass unnoticed.

Do not forget that at the time when Lamarck wrote no rational explanation of the geological imprints had as yet been suggested. Marcel Landrieu, in his remarkable work on Lamarck,¹ very properly reminds us that Buffon had been obliged by the Faculty to make 'an ignominious retraction of the geological truths which he had enunciated.'²

¹ The reader can also profitably consult the excellent study of Lamarck's work by Edmond Perrier.

² If we are to regard Buffon as a distinguished pioneer, it is only fair to associate with his name the name of Maupertius, and, above all, the name of Diderot, who with astonishing prescience boldly lifted the veils of the mystery to disclose as if in a prophetic vision the connected links of evolution. He says: 'There has been a consecutive progress from sensation to ideas, to thought,

On the origin of fossils Leonardo da Vinci put forward the idea that 'the mud of rivers covered and thoroughly penetrated them when they were still at the bottom of the sea near the coast.' And, later Fontenelle wrote: 'It took a maker of earthen ware who lived toward the end of the 16th Century, and who knew neither Greek nor Latin (Bernard Palissy),¹ to dare to say in Paris and in the face of all the doctors that the fossil shells were actual shells left by the sea in other days in the places where they were later found; that animals had given to the figurate stones all their different shapes, and that he boldly defied the entire school of Aristotle to attack his proofs.' General opinion, however, continued to hold that fossils were but 'freaks of nature,' or else that they could be explained only by Noah's deluge.

After Buffon and Lamarck, we must credit Goethe with having been one of the principal founders of experimental biology. His observations in the field of comparative anatomy and his researches in the realm of the progressive transformation of plants (which is really evolution) opened the gate through which modern science has definitively passed. The enthusiasm with which he espoused the cause of Saint-Hilaire in his great contest with Cuvier over 'the principles of zoölogical philosophy,' proves clearly that he entered into the subject heart and soul. On the eve of his death in 1832, he was still devoting much thought to it.

Huxley, who attributed only a secondary influence to the Lamarckian constituents of evolution (habits and environmental conditions which were the results of the 'normal' activities of assimilation and disassimilation), nevertheless awards to Lamarck, because of his first theories of hydrogeology, more credit than to Cuvier.

to reflection, to consciousness, to sentiments, to passions, to signs, to gestures, to sounds, to articulate sounds, to language, to laws, to science, to arts; there have elapsed millions of years between each two of these developments; there are perhaps other developments to be undergone and other aggrandizements to be received that are to us unknown. . . .'

¹ Let us not forget the atrocious brutality with which the Inquisition thwarted the labors of the unfortunate Palissy, who, urged to let himself be converted, in his dungeon in the Bastille, simply replied to the King: 'I know how to die.'

Darwin — who spoke of Lamarck with contempt until the day when he finally realized his error — was to achieve the brilliant success of conclusively proving the theory. Nothing could be more foreign to the thought of that English scientist than the formulation of the sort of sweeping generalizations in which Lamarck had specialized. An invincible prejudice, due to limited experience, prevented him from boldly concentrating his attention on the great laws which at the start might perhaps have disconcerted him. However, without a trace of timidity, he resolutely entered upon the hard struggle of the innovator and held his ground as the horizon widened and as his inferences confirmed his belief in the correctness of his theory. He never ceased declaring that for fifty years others had announced the theories which it was his task to repeat and to confirm by observations. He considered his work on the 'Origin of Species' as nothing 'but one long argument.' If argument follows the experimental method, it unfolds normally and can go far.

No one ever sought publicity less than Darwin did. No uproar of orthodoxy could make him recede.¹ Lamarck, fifty years before, had borne the first shock of the 'scandal.' It fell to Darwin to bear that trial with serenity, and while it lasted he seemed to think most clearly.

Meanwhile in France Saint-Hilaire boldly opposed Cuvier, who, by adopting the theories of comparative anatomy, became famous as the founder of paleontology, but who vehemently rejected the idea of kinship with the animal kingdom,² and claimed that each species was segregated in its own particular compartment. The academic victory of

¹ To people who reproached him for maintaining doctrines subversive to religion, Darwin replied with a smile that Leibnitz in the same way found fault with Newton's law of universal attraction, as 'subversive to natural religion, and consequently to revealed religion also.'

² I have called attention to the lesson to be learned from a man who devoted himself to pointing out, with the aid of the correlations of the organs, the proofs of our kinship with the animals, and who, at the same time, steadily strove to break down the links between them and man, although his own teaching maintained a contrary point of view. It is remarkable that the same man who had opened up such fields of human knowledge should forbid people to enter them.

a leader who did not attack Biblical creation, was sweeping but short-lived. The dust of battle could not for long obscure the convincing evidence supplied by Boucher de Perthes, which irrefutably proved that man had lived while the sediments of the quaternary strata were being formed. Lyell completely annihilated the theory of terrestrial cataclysms formulated by Cuvier to support his thesis and upheld the doctrine of the gentle action of long sequences of modifying influences. Agassiz was the last champion of a doctrine to which no one, except the clergy, any longer pays attention.¹

I should have to quote extensively from Lamarck to show how he dealt with the problem. Extracts skillfully chosen by Landrieu permit us to follow the course of his scientifically verified inferences to his ultimate conclusions. The progress of organic development from the absorptive nutrition of the protozoan to the most delicate phenomena of differentiated functions is outlined in a theory which later he bases on the fundamental conception embodied in the famous formula: 'the need creates the organ.'² The development of the power of reproduction is in like manner traced from 'scission,' then through 'external generation' and 'internal generation' until sexual generation by means of the egg is reached. 'Thus,' says Landrieu, 'Lamarck included life among the natural phenomena; what before him was the domain of metaphysics became a physical science, and to that science he gave the name of biology.'

As to the trick (quite necessary to our intelligence) of classifying into species, genera, etc. (which have no real

¹ 'It is one thing unthinkingly to admit more or less isolated suggestions or more or less vague philosophical principles; it is quite a different matter to group those things even into an imperfect system, to deduce from them an hypothesis appropriate to the formation of organic bodies, and thus to strive to determine the laws of the origin of living creatures.' (Lamarck.)

² At bottom this is merely one aspect of the denominating formula, 'matter-energy.' As I have said, the original formula was: 'the function creates the organ.' The function results from the activity of the organ; it cannot consequently precede the organ. 'Need,' like 'attraction,' is the subjectively initial evidence of a perceptible form of action.

objective existence),¹ he declares that 'if we could see a complete set of the dead forms which have succeeded one another in the past, they would destroy our classifications.' Since we can see only fragments of series, our powers of understanding have forced us to assign them limits. In the order of nature there are no such limits. It required a notable mental effort to understand that fact. But Lamarck had no illusions as to the opposition to his views. 'It is easier,' he philosophically remarks, 'to discover a new truth than it is to get it accepted.' That, in a word, is the whole history of human thought. If classification according to similarities and differences has objective cosmic value, it becomes only a matter of distinctions among phenomena (that is, among activities) which are as open to the reproach of being subjective as are the classifications themselves. This is true because our sensibility is so constituted that it reacts to the shock it feels at each recurrent break (*quantum*). If the species disappear in the organic world, there will remain only individuals, that is, individuations of complexes differentiated from one another by their organic functions, the transmission of which will be all the more various, according to the complexity in the relations of the plastids (cells) to their environment.

As a consequence of the enormous lapse of time, variation is the eternal law, and the one thing impossible to conceive is precisely that immobility which at first was considered as the determinant of knowledge. This point became obvious when the discussion at the Academy of Sciences between Cuvier and Saint-Hilaire on the 'unity of plan in the formation of animals,' proved that if the theory could result from observing adult vertebrates, it must embrace the whole kingdom of animal life if the phenomena of embryogeny were

¹ Even Linnaeus was not innocent of some transformistic conceptions. For Cuvier, species were forms which had been 'perpetuated since the origin of things.' How long might that be? The school of Cuvier willingly admitted that the earth was approximately six thousand years old. The man of Chapelle-aux-Saints, who existed some dozens of thousands of years ago, must have smiled at that idea amid the fossilifications of his quaternary age. The fundamental principle of the theories of Lamarck were based on indefinite time.

examined. I am not going to enter upon the history of fecundation and of its derivative phenomena. But I must mention in passing the so-called law of patrogeny, which the school of Saint-Hilaire formulated in these terms: 'the embryogeny of an animal is merely an abridged version of its genealogy.' Since the formula does not take sufficient account of the evolution of all the constituents, it is doubtless too absolute. But should we not be satisfied if we find in the synthetic evolution of the embryo a synopsis of anterior stages of evolutions? In speaking of the similarities in various embryos (including that of man) which Haeckel emphasized, I have already mentioned the fact, and I called attention to the point that in the case of the human embryo it did not involve a complete series of transitions through all the precedent forms. However, Cuvier himself, in view of his law of 'organic correlation,' cannot be said to have disputed the decisive significance of the parallelism between the genealogically earlier stages of evolution and the present stage of evolution.

Thus, the species, or, if you prefer, the group of similarities brought together through our classification, moves or evolves between the two unequal forces needed to set up the movement; one, the hereditary conservation of forms which tends to keep the individual true to his morphology, and the other, the instability of those same hereditary relationships, which, by the law of least resistance, are swept into new formations.

We propound the principle of evolution as, following Lamarck and Darwin, we understand it to-day. It is not to be supposed that either one of those scientists reached his conclusions all at once. Considering the interpretations which had to be subjected to the test of observation, they were obliged to enter bravely into the thickets of hypothesis, hatchet in hand. I cannot be expected to follow them in that laborious undertaking, in the mazes of which I should become inextricably entangled. The reader who wishes to study the subject extensively will find numberless works to help him. I can do no more than emphasize the important points.

Lamarck's fundamental idea is that in the course of time 'habit' or 'use' or 'activity' brings about clearly defined variations. At first people paid only passing attention to this theory. To-day, it appears that in the long run those 'variations' are the inevitable components of transformism, as manifested by evolution. Is this not proved by the striking changes which result from gymnastic exercises, which are no more than systematized habits periodically practiced? As every one knows, the biological consequences of the simple repetition of a simple muscular contraction are marked by an increased vitality. With repeated exercise the organ will soon be enlarged, as is shown every day by the development of well-exercised muscles. That profound thinker, Turgot, had clearly recognized the truth when he complained that our 'education' consisted in establishing rules for children when we should be creating 'habits.' And, since the word education implies the idea of an evolution, we can say that on this point Turgot anticipated Lamarck in defining one notable element of evolutionary transformism and its tendency.

The fact is that the forms and tendencies of all organic activity necessarily find a counterpart in every related functional development.¹ The repetition caused by 'habit' does not mean simply superimposing one motion on another. The law of effort, based on the need of nutrition, requires progress (like that of imbrication) along the line of least resistance, which determines the transformation or the evolution. If action and reaction required the same total expenditure of energy by the organ, they would neutralize each other, which is the same as saying that cosmic motion would stop. Now, since the law of motion is that it continues without pause, the continuity cannot be obtained except through the antecedent phenomenon's developing in the direction of the succeeding phenomenon with a rapidity which increases as the resistance gradually diminishes. Thus the newly oriented waves of energy,

¹ Consider, for example, the reciprocal relations which exist between flowers and insects. Darwin quotes many examples of this sort.

which need only a sufficient length of time to become settled and definite in character, become linked together as a connected series.

'If human life lasted but a second,' said Lamarck, 'we should state as a positive fact that the pendulum does not move.' Man, because of the brevity of the time at his disposal, necessarily measures cosmic changes by his own yard-stick, which is an imperceptible standard for immeasurable activities. Time holds us in its cruel grip, since we constitute only a moment of evolution. On the other hand, evolution itself, which never stops, has limitless time at its disposal. Lamarck has written at length on the hardly perceptible differences which separate such or such species from the species most closely resembling them. What yard-stick can we use for estimating unlimited space and time?'

In terms of the electronic system itself, the complexes formed by the sum of the qualities of any individual, give us, in the state of our knowledge, objective bases on which to build up the subjective classifications which compose it. As Lamarck says more than once, if we could know every link in the chain of phenomenology, all our classifications would disappear. This is equivalent to saying that if once

¹ India felt the inadequacy of human standards of measurement and tried to remedy the matter by being prodigal of numerical extravagances. A 'Koti' equals ten millions. A 'Kalpa' (or the age of the earth attained between one destruction and the next) comprises four billion, two hundred and thirty-eight million years. Each Kalpa constitutes one of the three hundred and sixty-five days of the Divine existence. Buddha, we are told, met with many vicissitudes during ten billion one hundred million Kalpas, etc., etc. . . . The Jains divide time into two periods, one ascending and the other descending, each having a duration of two quadrillion 'oceans' of years, and each 'ocean' is equivalent to a quadrillion of years. If you compare those figures with the dimensions of the Cosmos, they do not seem so senseless. Physicists have determined the volume of the molecule, and if we are to believe their figures, we find that a cubic millimeter (approximately the volume of a silkworm's egg) contains a number of molecules at least equal to the cube of ten millions, that is, a unit followed by twenty-one ciphers. One physicist has calculated that if any one should count them, and if he could count a million a second, it would take him more than two hundred and fifty million years. A person who had started on this task at the time when our solar system was but a shapeless nebula would not yet have finished. (R. Dubois, *Leçons de physiologie générale et comparée*, quoted by Th. Ribot.) What would happen to such measurements if applied to infinite space and time?

we knew everything, we should know nothing, since we should no longer have anything relative to classify.

Physics, chemistry, and biology establish elementary groupings of phenomenology which, in opposition to the idea of element, set up the idea of environment, that is, the idea of the alternating action and reaction of the Cosmos which govern everything everywhere and always. That idea of environment, based on elemental conditions, was the basis on which Lamarck relied as the foundation of the theory of the necessary relations of the successive individualities which in space and time make perpetual evolution. Elements and environments are, indeed, the junction of the cosmic energies which combine to form the activity of the individual.

The actions and reactions of individuals and of their environment, evolving according to their synergies, developed and strengthened by habit (changing them from conscious into reflex activities), which, by means of hereditary accretion, maintains and stimulates the activities of coherent sensations transmissible under the name of 'acquired characteristics,' — these were the materials of which Lamarck built his vast generalization. We have striven to connect hereditary cause and effect as closely as possible, but have found only a prolongation through reproductive processes of previously established coördinations.

Lamarck considered 'species' as a relative constancy in the collective characteristics of the group in a stable environment. To-day we should say that the environment never ceased changing, and that all characteristics transmitted through heredity imply changes as much between one individual and another, as between one species and another, and that these changes, the laws of which we often fail to understand, constitute the 'differences.' Cuvier, who segregated each species in individual compartments, erred in noting differences only, and in taking no account of the great number of similarities. Resemblances, however, must be explained quite as much as disparities. In untrained minds the error is pardonable; in trained minds, it is merely

a natural tribute to human fallibility. One should not forget that Auguste Comte on his own personal authority forbade stellar researches, which he deemed useless, but some of which have already brought about discoveries of the greatest importance.

How could one expect Lamarck's great discoveries to attract public attention amid the confusion of the Napoleonic period? ¹ The unfortunate scientist was born under an unlucky star, for soon the brilliant fame of Darwin, his successor (the most modest of men), which should have brought the name of the great Frenchman into relief, caused him to be forgotten.²

¹ Nothing better illustrates the relations between the two men than the well-known scolding administered to the scientist by the Emperor. It does little credit to the unrestrained autocrat. When, in 1809, Napoleon received the members of the Institute, Lamarck thought it his duty to present his latest work on natural history to the great man. The master had heard it said that Lamarck was occupying himself with meteorology. He therefore violently upbraided him for dishonoring his old age by writing almanacs. Dumbfounded, the unfortunate scientist burst into tears.

Still, Lamarck escaped the indignity which Volney, author of *Les Ruines* suffered when there was no question of any misunderstanding.

'France needs a religion,' the Emperor declared dogmatically.

'France needs the Bourbons,' the scientist quickly retorted.

The Emperor replied by a kick in the stomach which sent the old man to his bed. (Taine, *Origines de la France contemporaine*.) 'Above all,' Napoleon liked to say, according to Edmond Perrier, 'don't meddle with my Bible.' We must admit that in his *Ruines* Volney had certainly meddled with the Emperor's Bible.

I know nothing of Napoleon's sojourn at Saint Helena except what I have gathered from Gourgaud's *Mémoires*. However, they satisfied me that the Emperor was never capable of unbiased self-examination. At the end of such a life as his, it never occurred to him to judge himself by any higher standard than that of the vulgar dais of his self-erected throne. His life was, however, excellent material for philosophizing. He made no use of it. When he relived his adventures — and that was his only form of meditation — he asked himself, not without a certain simplicity, what Eastern empire he would have won, had he not let himself be stopped at Saint Jean d'Acre. After that, silence. For him there was no farther horizon. Of man and his destiny, of the drama of his existence, of France otherwise than as it was related to himself — nothing. He made no attempt at any summing up. He felt no exaltation; he had no trace of idealism.

² At the beginning of the final edition of Darwin's *Origin of Species* he says: 'Lamarck was the first person who by his conclusions attracted any serious attention to the subject of the origin of species. This justly celebrated scientist championed the doctrine that all species, including man,

If by his brilliant theory of natural selection amid the struggle for life Darwin provisionally obscured the Lamarckian theory of habit and environment, the time was bound to come when a true balance between them would be reestablished.¹ The influence of environment, of which Lamarck supplied so many examples,² could not fail to attract attention through the arrested development of the growth of organs, according to functional activity in the struggle for adaptation. Consider the arrested development of the teeth of the whale, although its foetus still has rudimentary teeth. Consider the atrophied eyes of the mole, the disappearance of the feet of the snake, etc. . . . The sum total of all those phenomena is the explicit proof of the doctrine of the inheritance of acquired characteristics, of which there are many examples in our barnyards, in our cattle sheds, and in our stables. English breeders have very successfully capitalized this aspect of heredity.³ Spencer did not hesitate to follow Lamarck in his sweeping generalization, and Darwin himself (last edition of the 'Origin of Species'), in his theory of the hereditary effects of use⁴ and of disuse, recognized the importance of selection.

descended from other species. He was the first to render to science the eminent service of declaring that all change in the organic world as well as in the inorganic was the result of law and not of a miraculous intervention.'

It required the labor of a whole lifetime to elicit from the eminent naturalist this honest estimate of his great predecessor.

¹ In a letter to Moritz Wagner (1876) Darwin wrote: 'The greatest error that I have committed is in not having taken sufficient account of the direct action of environment, that is, of nourishment, climate, etc., independently of natural selection. . . . When some years ago I wrote the *Origin of Species*, I had collected only a very few proofs of the direct action of environment; to-day there are many.'

² On many occasions a well-known plant, owing simply to a different environment, has been thought a new specimen. Domestication gives many hints of that kind. Wheat no longer exists in a wild state. Yet it was first discovered wild. The same is true of the dog.

³ In game drives through the Parisian preserves, the hen that was foster mother, but who has not deserted her brood, sometimes goes by with the covey of young partridges and with them faces the guns. She has become less refined in structure, and certainly roosts in trees; her feet are strongly developed, and the strength of her flight is notably increased.

⁴ 'Use,' as I have already pointed out, is simply the functioning of the organ. Lamarck calls it 'habit.'

Moreover, Lamarck himself gave a distinctive character to his general conception by recognizing the principle of the struggle for life. He says: 'As a consequence of the extreme multiplication of minor species and especially of the more imperfect animals, the multiplicity of individuals would interfere with the preservation of the races and with the preservation of the progress attained in the improvement of the organization if nature had not taken precautions to limit that multiplication within bounds which it may not overstep.'¹ All animals, except the herbivora, who are the prey of the carnivora, and who can avenge themselves only on the grass, devour each other.

So far as the animal descent of man is concerned, Darwin, who only rarely refers to Lamarck, reproduced and developed the fundamental observations of his predecessor, who did not hesitate to follow the developments of his thought even into the phenomena of the formation of language.

Every vital force, regardless of form, is but a moment of organic activity in the course of evolution. That fact is the anchor which holds the chain of Lamarckian inferences. The test of observation will establish whether the elements of coördination have been more or less successfully recognized.² The necessity of every animal to eat in order to live, to preserve itself, to develop itself within its organic limitations, to reproduce itself, to keep itself from pain, and to seek pleasure, from the lowest stage of sensation to the highest, stimulates all our vital activities, both individually and as a whole. We can follow the development of sensibility, with its successive reactions of sociability, and of morality, and we can even discover indications of future developments. The scientist cannot fail to note this deter-

¹ The phraseology is that of the period. The idea, nevertheless, is perfectly clear.

² In contradiction of his own teaching, Lamarck does not, for example, recognize 'will' as existing elsewhere than in the higher vertebrates. If wholly without will, how could the amœba distort itself in order to obtain its food? The distinction is only one of words.

minism, with an idea of tracing new outlines of comparative biology.¹

In 'A Naturalist's Voyage Round the World,' Darwin published his notes made during a five years' voyage through the southern hemisphere aboard the *Beagle*. He started in 1831, at the age of twenty-two. He had even then an excellent equipment in the natural sciences, but he was in no haste to reach conclusions until after he had spent a long time in observation. The book appeared in 1848. He studied the geology, the flora, the fauna, and even the human beings of the lands he visited, but nothing betrays the brilliancy of the thoughts that were shaping in his mind. However staunch a Protestant he was, the brutal domination of the Catholics over the Chilean Indians seems not to have struck him. He tells one or two anecdotes on the subject, and that is all. He tells the story, for example, of the Padre who regarded it as highly suspicious that the King of England should send 'a poor adventurer' to the Andes in order to collect flies and lizards. Darwin made no further comment.

We are surprised to find mention of Lamarck in the beginner's notes. As a matter of fact, no mention of the French scientist occurs either in the 'Origin of Species' (except in the last edition) or in the 'Descent of Man,' where some mention of him would seem essential. On the other hand, at the very beginning of his voyage, Darwin takes pleasure in bringing up Lamarck and his theories in order to ridicule them. This he did in connection with a small rodent which lives underground and whose eyes, like those of the mole, appear to be atrophied. Lamarck, he writes, 'would have rejoiced in this fact, had he known it when he discussed (with more than usual acumen) the "gradually acquired blindness of a rodent which lives underground."' What is remarkable in this passage is that the author should have happened to hit upon a very distinct

¹ That monkeys are susceptible to human syphilis is known. In the majority of cases, all vertebrate organisms respond with identical effects to the action of identical medicines.

affirmation of the doctrine of the inheritance of acquired characteristics, superlatively a Lamarckian principle, but of only minor importance to the school of Darwin. Furthermore it is not merely a verbal slip, for, speaking of the tameness of the birds on the Galapagos Islands, Darwin expressly says: 'These different facts' permit us, I think, to conclude that birds do not individually acquire this instinct (of wildness) in a short time, even when they are persistently hunted, but that in the course of succeeding generations it becomes hereditary.' It is impossible to speak more clearly. It was surely Darwin's right and duty to modify his ideas. But why should he rally Lamarck so harshly at the very moment when he was upholding the opinions of his eminent predecessor?

At this point, as was inevitable, the young naturalist ran foul of questions which did not cease to haunt him later. In the case of the big crab that hammers, breaks, and drills the cocoanut, he catches a glimpse of the doctrine of adaptation, but overlooks it. The case is the same in respect to a certain petrel of Terra del Fuego, at once a diver and a bird of strong flight, which while on the wing lets itself fall straight down into the water as if mortally wounded. 'The form of the beak and of the nostrils of this bird, the length of its foot, its habit of diving, and its choice of habitat to a remarkable degree ally it with the penguins.' Later, the future transformist was bound to meditate on that theme. The extremely abject state in which he saw the Fuegians — a state lower than that of the Australian aborigines — already led him to wonder about the first man, concerning whom at a later day he was to publish such sensational theories.

Independently of the value of his observations, these notes of his cruise are of great interest as indicating where the man whose name, after Lamarck, was to be associated with the most natural and the most unexpected conception of planetary life began his scientific studies. It is curious to

¹ He is speaking of thrushes and yellow-hammers 'so tame that they can be caught in a butterfly-net.'

see him begin that formidable task by gravely asking himself 'for what purpose' such and such species 'had been created.'

In general, Darwin's method is rigorously to limit his research to the exact dimensions of the immediate problem. Not only does he avoid precipitate conclusion, but he confines himself wholly within the narrow domain of a particular observation. Thus any premature generalization would only be a hindrance to him. The method indicates his extremely strict sense of scientific obligation much more than it does any fear of shocking the ignorant. On the other hand, when he once reaches a conclusion, nothing can make him change his opinion. Nevertheless, in order so far as possible to safeguard socially his scientific position, Darwin, like Lamarck, is careful to uphold the doctrine of an intangible 'Creator,' although he submits all the problems of the 'created' world to the tests of experimental science. With that reservation, he becomes strictly logical in laying down a scheme of terrestrial life completely contrary to that of the Bible, which he systematically ignores.

He begins without preamble. He does not digress. The single point to which the persistent investigator devotes himself is what Humboldt referred to as that 'mystery of mysteries,' the origin of species. Other men were to consider the problem together with every kind of inference possible; Darwin circumscribed the field of his observations, but could not be dislodged from any position which with immense labor and with the nicest skill his indomitable perseverance had taken.

His thesis is, as every one knows, the Malthusian law which maintains that many more individuals are born than can possibly live — which causes the competition for subsistence, for growth, for multiplication, in short, the struggle for life. The premise is unquestionable. The best endowed and the best adapted individuals supplant the others; that is natural selection, and its operation is as inexorable as fate. Since potentially superior organisms transmit to succeeding generations more energy than

others, the influence of natural selection in the long run becomes dominant. Are acquired characteristics directly transmitted? Lamarck plainly asserts it, and Darwin¹ admits it, but only to omit further discussion of the problem.

It is enough to note that there would be no evolution, and consequently no Darwinian transformism, if the constituent characteristics of the ancestors did not some day reappear among the new species as traits acquired by inheritance. The crossing of species — accidental or intentional — of which any farm supplies excellent examples clearly illustrates the point.

I must be brief, but I cannot ignore the fact that the highly valuable proofs collected by Lamarck and Darwin, quite sufficient, as they are, to establish the broad lines of an experimental generalization, must for their final verification be modified in the light of subsequent scientific discoveries. The new field of study open to our constructive criticism is infinite. From the original generalizations of science to the strict verification of the incessant revelations of experiment, is a long road, full of surprises. Is it not wonderful that man can successfully match his strength against the omnipotent elements?

New discoveries will continue to be made about the processes and the effects of evolution, since we shall never attain complete knowledge. Every discovery will cause a constant recasting of our ideas, both individually and as a whole, as to those processes and results and as to everything else. The fame of Lamarck and of Darwin will not be affected. They were the first to see and to speak. That is enough to make them great.

In the first pages of his book Darwin goes to the root of the problem, as might a general overseer of the universal business of life charged with the task of guiding all organic activities through every phase of coördinate evolution. He is Proteus, the shepherd, god of transformations, leading his symbolic flock of the diverse forms of life which one after

¹ 'The mere calculation of probabilities almost obliges us to attribute to heredity the reappearance of any deviation.'

another he causes to appear under the light of heaven, or to return to the depths of the fathomless ocean. We see the problem of the relations between all the forms of a universal sensibility, appearing only to vanish. The universe takes on an entirely different aspect from the one it wore in the days of primitive and incoherent thought. The curtain rises on a conscious humanity and on the syntheses of effort which destiny imposes on it.

To-day we have no trouble in understanding the interpretations which Lamarck so exactly coördinated. Naturally, they did not leap to life full grown, as the result of a sudden inspiration of genius. He began by believing, as did the whole scientific world, in the permanence of species. It is not my task to recount the complex detail of the huge labor which led him to his great generalizations. That might well be made the subject of some work on psychology, but it is too remote from my subject. An even finer enterprise would be to portray the scientific idea fumbling in the obscurity of the laboratory, struggling against the ignorant mob,¹ and the affected disdain of academies that fear nothing so much as running counter to 'accepted opinion.'

The scientist interested only in the accuracy of his experiments should first of all train his mind to an especial acuteness in dealing with problems, and if by great luck his courage is crowned with success, if he is able to become a genius of penetration who triumphs over accumulated obstacles, what is in store for him? Consider Lamarck being judged by Napoleon, or, even worse, being judged by Cuvier, or by Darwin himself. I omit all mention of the Church. We know what its verdicts have been in the case of Science *vs.* Dogma. Scientists are mortal. If they have the courage to persist, their most violent discussions, regardless of form or subject, serve the great common cause of an understanding of things.

Apparent scientific contradictions did not discourage Lamarck. Fully aware that, like any one else, he might make

¹ I so designate, without regard to social position, the amorphous social group of men of inferior culture who care little for enlightenment.

mistakes, he welcomed them and asked of criticism only that it be constructive. He was first appreciated in a foreign country¹ when, after Darwin's brilliant achievement, every young scientist could discuss, review, and, if need be, reconstruct the principal elements of organic evolution. Darwin, paying no attention to anything except to the survival of the fittest and to natural selection, which he had so exploited, had not given sufficient consideration to the fundamentals of the phenomenon of evolution. He had suggested an explanation of the 'miracle,' and since the explanation had a sensational novelty, the modest naturalist of other days did not have much chance even among men with a leaning toward generalization. Lamarck, however, could not be overlooked. The great man had died without reaping the rewards of victory; but it was he who had begun the battle, and it was he who by the acuity of his insight had really won it. On the other hand, Darwin, gifted with a marvelous genius for patient persistence, had fought all the important supplementary battles which made possible the final victory of the recognition of universal evolution. The two men were so great that without offense to either we can pay them joint gratitude and joint admiration.

In the names of the conceptions of their respective leaders, the neo-Lamarckians and the neo-Darwinians can continue to exchange superficial or profound criticisms. We should not complain. Science must be the gainer. Nevertheless, it must be said that disciples — very distinguished no doubt, yet sometimes without the inspiration of their masters — may easily be led astray.

As to what constitutes the variation able to produce the actual transformation of one species into another, De Vries had an inkling of the phenomenon, and Jacques Loeb does not hesitate 'to class that discovery with the experiments of Rutherford, of Soddy, and of Ramsay on the transformations of chemical elements.' De Vries discovered that if the seeds of a plant known as *œnothera lamarckiana* are

¹ It was a Mr. Packard, an American, who undertook to make Lamarck known to the next generation and to proclaim his genius.

planted, a certain number will produce new species, 'differing from the parent plant by quite definite characteristics.' The essential fact is that the seeds of those new species always reproduce themselves, but do not necessarily reproduce themselves in the original form. That discovery modified the transformist idea, since it proved that new forms can be produced suddenly, and not always, as Wallace and Darwin had supposed,¹ through a succession of insensible variations. This is what De Vries called a sudden mutation. Thus a new field of discussion was opened, but I admit that as I see it time has nothing to do with the matter, since time is nothing but one of our subjective criteria. Some mutations are sudden; some are imperceptible. That we have grasped the fact of mutation is the principal thing. To sum up, transformism must be the combined effect of the components of conservative heredity and of the elemental action of evolution.

We can define the cell as we have the atom, for it is something like an organic atom, for which the protoplasmic membrane, the nucleus, and above all the protoplasm create by means of osmosis the particular forms of activity in a complex in which the life of the organ takes place. I have briefly outlined the activities of the atom. It would be impossible to do the same in the case of the cell, the nucleus, or the protoplasm, for the subject would lead me too far afield. The structure of the histological elements of the tissues has been very closely studied. Theories have been based on the observations made and have been supplemented with hypotheses which remain to be proved.

Any one wishing to get an idea of those theories should consult that very sound book by Yves Delage, 'L'Hérédité et les grands problèmes de la biologie générale.' In it the physiology and the chemistry of the cellular organ are methodically examined in the light of the works of the most authoritative scientists — a proceeding the chief obstacle of which is that each student is apt to cling to his own theory.

¹ Jacques Loeb, *The Dynamics of Vital Phenomena*.

The nutrition of the elementary organ consists of assimilation and disassimilation. The movements of the protoplasm, and of the nucleus constitute the purpose of the cell, the principal function of which is reproduction by division — wherein lies the secret of heredity. Regardless of form, generation always results in cellular evolution. Scissiparity, budding, sporulation, asexual or sexual reproduction, and parthenogenesis in various forms all raise the problem of heredity, which is continually at work in the form of embryogeny, with or without the peculiarity of metamorphosis — familiar in the case of the butterfly.

In the case of species, and all the more in the case of genera, Delage holds to the theory of descent, which implies transformism. He holds to that theory, not because he regards it as 'experimentally' proved, but because otherwise one is driven to accept the hypothesis of spontaneous generation. 'The problem of phylogeny,' he writes, 'is not whether it exists or not,' but how it occurs.' Let us accept the problem as such.

Heredity and variation both go to the root of the origin of species. Delage asks these two questions: first, 'how and under what forms are such minute and varied characteristics as those which daily observation shows us are transmitted in the sexual products, and, second, how if acquired characteristics are transmissible, can the modifications produced in the body be transmitted with such remarkable precision to the germinal cells which do not yet contain any of the organs which are to be modified?'

I make a point of mentioning these problems, because so far we have set up only preliminary hypotheses to cover them. The fact remains that heredity and variation are the bases of organic reproduction. Ultimately we shall know more of the problem.

I have mentioned the great controversy as to the in-

¹ 'To prove that transformism is the only theory which a purely scientific mind can accept, it is enough to note that a dog and a man have four limbs, a head and a trunk, eyes, heart, a digestive tube, etc., . . . and that, in sum, all living creatures, or at least large groups of them, are constructed along the same broad lines.' (Delage, *L'Hérédité et les grands problèmes de la biologie générale.*)

heritance of acquired characteristics, which is the cornerstone of Lamarck's doctrine. Darwin, who accepted it, finally relegated it to a secondary rank, but could not do without it. The reader will find all the details of the debate in Delage, who reaches no definite conclusion, because he tried to eliminate evolution, which he could not reconcile with the famous theory of the immortality of the germ-plasm. Apparently he does not consider it enough merely to transmit a progressively active potentiality.

Without the inheritance of acquired characteristics, of which we see such remarkable examples, plants, animals, and men would have remained what they were in the beginning. If only innate characteristics could be transmitted, what was the origin of those characteristics, since no element in them could ever have been acquired? Furthermore, how could that alleged stability be reconciled with the obvious and many changes? Le Dantec thinks all transformation must be accompanied by loss of energy — the loss determining the evolution of the organ. And he goes on to say: 'The two antagonistic phenomena, assimilation and variation, the inheritance and the acquisition of characteristics, are both phenomena of resonance. In the first phenomenon, the protoplasm communicates its vibrations to its environment; in the second, the environment sets the protoplasm to vibrating in unison with itself. But both are invariably phenomena of imitative repetition.'

The truth is that heredity and variability are the two poles of evolutionary action, which set them working against or with each other, as the development of the organism may require. The follower of Lamarck sees variation as the principal effect of habit; that is, of repeated action. The follower of Darwin relies on natural selection. Darwin himself finally came back to his starting-point, when he accepted the theory of the inheritance of acquired characteristics; and the neo-Lamarckian of to-day does not dispute the secondary effects of natural selection. If, as Delage remarks, 'each new advance ceased with the death of him who made it, no change could ever occur except through blind

selection. It remains to be proved that selection can of itself explain everything, including adaptation, evolution, and regression. The burden of proof is on the neo-Darwinians, and it is not an easy task.'

Let us leave neo-Lamarckians and neo-Darwinians to fight their battles. However, let us note that every day we cannot avoid seeing numberless cases of the inheritance of acquired characteristics, although to some it has seemed theoretically contestable. We shall never lack theories when we need them. Since our knowledge consists of observed truths, even at the expense of atavistic, that is to say, of inherited, errors, how, in the face of the fact that man does change, can any one deny that he transmits his qualities, not such as he had them on the day of reproduction, but such as he has successively exhibited them at various subsequent periods of his life? When I say 'man' I necessarily have in mind the whole complex inheritance of the reproductive couple. Since heredity brings about a continuation of the variable creature, what sort of heredity would that be which could transmit none but non-acquired characteristics; and in that case what explanation could there be of human development? Heredity no doubt requires a vast number of constituents. Nevertheless, if there is to be an orderly development of admitted activities, those activities must in some way be linked together. The forces which determine whether such or such characteristics shall be acquired, form the basic element of a coördination which cannot be shattered without at the same time shattering the Cosmos. If heredity merely meant a partial transmission of elements from which those which give the human potential its distinctive character were excluded, the unbreakable bond of that coördination would, in fact, be broken.

I will deal as cursorily with variation as I have with heredity. To me the two are merely opposite aspects of the same organic force, a force which is destructive to the Cosmos, and which seems, according to the point of view, to cause the unceasing integration or disintegration of all complex structures. I recognize the two just as I do gravitation,

with which they are necessarily connected. As a result of generation and of the resultant heredity, the organic complex has a tendency to be preserved, but the action of that tendency occurs amid conditions where the multiplicity and variety of the influences which compose it must become adjusted to the eternal activity of the elements which is the basic quality of the Cosmos. By the same token, heredity and variation are fundamental laws of the universe. The only difference is that personal experience convinces us of the existence of heredity, whereas we cannot see the slow progress of imperceptible variation. That is why we should not be surprised. The innumerable problems of heredity of which I make no mention always hark back to those which I have pointed out.

To sum up, Delage considers variation as 'a universal phenomenon which includes all creations, and which influences all characteristics.' 'Darwin's great merit,' he writes, 'is that he grasped and proved that nature is not fixed, but incessantly varies.' Lamarck had the intelligent idea that species might vary for the purpose of transformation, Darwin found out that they vary constantly, even when no transformation occurs.'

Accordingly we can say that as biological activity consists of continuous mutation more or less permanently stabilized, every individual is the result of combined heredity and variation. The truth is that cosmic energy is everywhere at work. Heredity prolongs the duration of the transitory relations which we term phenomena, and variation by setting up different coördinations shortens their course. Since every transformation is necessarily accompanied either by a loss or by an increase of energy, Le Dantec, after having proved that it is the loss of energy which determines the evolution of the organ, proposes that we regard 'the principle of the conservation of energy and the principle of evolution as equivalent terms.'

'Species,' Delage tells us, 'could only derive from variations that have become fixed.' That is true; but we should

* Buffon noted the first signs of variability.

not confer on that fixation the character of a finality which, inherently, it cannot have. In terms of the Cosmos, as we now understand it, the word fixation can describe only the more or less prolonged transformation of one kind of action into another. When the complex activities that produced the species have completed their task, Delage least of all would be willing to consider them as permanently segregated in a sealed receptacle. Activities will never come to a stop. They will continue to function through a succession of perpetually effective generators in other forms, determined by the correlations of their component parts. The result of their actions must be new variations, whether slowly or quickly accomplished. Delage clearly understands that fact; I argue with him merely for the sake of clarifying my own ideas.

The statement holds in the case not only of species, but of all biological classes, the alleged fixity of which lasts for only a limited period. Certain persons regard varieties as minor species less sharply defined than the major species, but no less solidly 'established.' I am disposed to look at the question from the opposite angle and to say that the species apparently most firmly established can be conceived of only as forms, the transition of which into new forms progresses more slowly.

In a spirit of extreme scientific caution, Delage writes: 'If we limit ourselves strictly to facts, we must admit that the theory that one species derives from another is not proved. The theory of descent rests on an absolutely legitimate deduction. It is the only one which is reasonable and scientific. But there is nothing in the facts which will convince those who will accept no proof except that which observation supplies.'

To me that statement, the result of a supreme attempt at scientific honesty, is nothing but the statement of a condition of human knowledge, for, owing to the relativity of our successive methods of attaining knowledge, doubt can never be wholly excluded in dealing with any hypotheses. Our thought consists of a series of mental states which can never

end. What we understand by the word 'fact,' which to us is supremely objective, is no more than the subjective reaction of human sensibility to transient cosmic activities which for a time have impressed themselves upon us. I tried to emphasize that point at the very beginning of this book. To say that there is nothing in facts, i.e., in the sensations awakened in us by phenomena, which can convince people who will believe only an explanation of cosmic action, is for love of theory to limit one's self to a very restricted gamut of sensations. If we could only place facts in a row, we should be like a multiplication table, a mere counting machine. But we think in terms of classified relations, and it is obvious that relations and classifications are not all equally well established. If we are sufficiently foolish to wait for the super-miracle of absolute proof, we shall spend a life of expectation in a quagmire of the blackest ignorance. We are very wisely content to accept shades of certainty, ranging from hypothesis to crucial experiment, without feeling obliged to wait until the end of time for verifications which may or may not be forthcoming, according to what form our evolution may assume.

The prism struck by the sunbeam gives us the spectrum of the elements of light; in like manner, our growing human intelligence, when it meets the resistance of the Cosmos, is broken into a spectrum of more or less completely assimilated elements, variously ranging from guess to certainty, which, set side by side, make knowledge. Instead of the man imagined by Delage, who will heed nothing except observed and barren facts, and who will take no account of the relationships among phenomena and of their interpretation, we actually have men who talk before they have observed, and men who have observed before they talk. Delage may take scientific pride in subtilizing every point which runs counter to his beliefs, but heredity and variation remain 'facts,' established as firmly as possible, and the ebb and flow of their interaction will continue to result in the rhythmic renewals which we call 'transformations.'

Thus, Delage does not argue against us, since his conclu-

sion coincides with our own. Biblical legend is our real opponent. It is, therefore, better for us to hold to Lamarck's and Darwin's theory of descent. We have the skull of the Neanderthal man and of the man of Chappelle-aux-Saints, the brain-pan and femoral bone of the Javanese Pithecanthropus. Obviously those are 'facts,' and the modern skulls with which we can compare them are also facts. We have not seen transformation (otherwise evolution), but we have watched so many successive transitions in every order of living creatures that we are forced to connect them with one another. Connecting one phenomenon with another is what Newton did when he observed the heavens and as a result formulated his theory of gravitation.

When environment and the inheritance of acquired characteristics began to be discussed, it did not put an end to the protracted argument. Buffon had reduced them to significant formulæ; he had even referred quite definitely to 'the struggle for life.' Lamarck, pushing straight ahead, undertook to trace the genealogical tree of the animal kingdom; this obliged him to take into account all defined characteristics as well as to analyze the phenomena which caused them. That master of cogent generalization undertook to retrace the course of the biological phenomenon to the physico-chemical phenomena which compose it. Lamarck applied himself to tracing its course in the vegetable kingdom and in the realm of protozoa. The modern school has followed in his footsteps all the more resolutely because our scientific classifications remain subject to the test of new discoveries. In the last analysis, from whatever angle we study the Cosmos we are inevitably brought up short by the eternal problems of substratum and of energy. The place of one need, more or less fully satisfied, must be taken by another, and the inevitable training derived from organic repetition will establish that 'habit' which Lamarck recognized as the dominant factor in evolution.

Originally we could discover nothing at the beginning of the organic series except the direct reflex action of the plastid to its environment. That represents the first stage

in the organic reactions of physico-chemical unconsciousness. No one can fail to see the apparently close relationship. On the other hand, in atrophy, which is the result of disuse, we find the organ reverting to the inorganic.¹ Whether evolution ends in exhausting or in developing energy, it is bound to fulfill its cycle.

Lamarck was so convinced of the inheritance of acquired characteristics that he merely mentioned it as an established phenomenon. It is certain that if one does not accept the principle of hereditary transmission, evolution would become a meaningless word. We should have to revert to Cuvier's theory of independent species. That would be difficult in view of the obvious and overwhelming testimony of inherited traits which, of necessity, were acquired in the course of organic development. The neo-Darwinians, who busy themselves with the distinction between inherited characteristics recently acquired and primitive phenomena of the same sort, have not as yet proved their point.

Man would still be at the 'inorganic' stage if the waves of cosmic energy had not the constant organic power to exceed the limits of the formations which originated them. That power is at the root of cosmic development. Without it, we should, in spite of the evidence, have to deny that, as fossils indicate, the organisms are logically interconnected and interdependent. Furthermore, we should have to go back to the Genesis of Moses, which, since it ignores 'facts,' wholly disregards distinctions concerning hereditary characteristics, which have been acquired, and which have been transmitted unchanged.

There is no lack of examples of acquired characteristics which have been transmitted through inheritance. Every form of vital activity makes it obvious that habits are in-

¹ The atrophy of vision that overtakes animals which live in the dark is a well-known fact. At the other extreme of the phenomenon, it is common knowledge derived from experience that the reactions of the skin to radiant light determine vision in the protozoan order. If the organic construction of the eye is held up to us as a miracle of finality, the marvel of its progressive formation in the absence of all preconceived design seems to me an even greater miracle, since we can follow it from beginning to end.

herited. On the other hand, such measurements of geological time as we possess make it possible for us to allot to the phenomena of transformism the time indispensable to the process. On the other hand, if we try to hurry the event, we are astonished that it does not materialize, even though we refuse it the primary condition essential to its manifestation. To cite a single case; is it not remarkable that among the ants which live on mushrooms, the size of the workers is much greater than that of the warriors? Their greater size is the result of habitual activity and of the inheritance of acquired characteristics. In the same way, because new needs demand more and more insistently to be satisfied, anthropoids descended from their trees and after long-continued effort succeeded in the decisive achievement of standing erect — a feat in which mimetic aptitude must have helped materially.

It is obvious what colossal labor it required to distinguish, by comparing variations and similarities, the various series of classifications essential to a scientific hierarchy of particular and general characteristics. What Lamarck especially emphasizes is that 'the conformation of individuals and their organs and the development of their faculties are the result of the conditions under which they live.' 'The conditions favorable to evolution,' says Edmond Perrier in corroboration, 'are the variations of climate, temperature, action of environment, many local causes, alterations and variety in the manner of living, of defending and of preserving life, and of assuring reproduction. The faculties of the animal diversified those different factors which were developed by use through the acquisition of new habits. The result was that new structures and new organs little by little appeared and were preserved and transmitted through the operations of heredity. Certain organs, which the animal used most frequently, developed, while others, which were not used little by little deteriorated.'

Lamarck certainly recognized the fact that, as Egyptian mummies indicate, organisms have not changed during the last two or three thousand years. But what is that period in

comparison with the measureless lapses of time which, as the most superficial examination of our geological deposits now proves, the Cosmos has at its disposal?

Lamarck attacks the most difficult problems of the mental organism just as courageously. 'As a matter of fact,' he says, 'we see a sort of gradation in the intelligence of animals, analogous to the gradation which exists in the development of their organization, and we become aware of the fact that they have ideas and memory; that they think, make decisions, love and hate; that they are susceptible to jealousy, and that by means of varied inflections and signs they communicate with and understand one another.' 'Reason' seems to him to constitute the capital difference between man and beast. But 'reason,' since it consists only of more or less skillfully classified experience, leads to mis-knowledge as often as to knowledge. Animals, because they have less of it, derive fewer advantages, but make fewer mistakes, as a result of their experiences.

Finally, I ought to emphasize the important observation that in the case of man 'the power of habit is in inverse ratio to the use of the intellectual organs.' Since, after all, 'habit' is only the coördination of reflexes, man, so long as he is not in a position to interpose the associations of mental images which give him the power to reach individual interpretations, must, like his ancestors, rely on his instinctive reactions to exterior circumstance. I have mentioned that this fact was the principal obstacle in the path of the evolution of knowledge, not only on account of the organic inertia itself, but also on account of the injection of social interests, the center of whose sphere of influence is inevitably the *status quo*.

Darwin does not go into the matter of elementary origins; the struggle for life and natural selection reach their full development only in life when in full activity. Thanks to the great discoveries of Pasteur, the study of the fecundation and development of germs brought into existence a science of embryogeny by which we have discovered the successive steps of the genealogy of the higher animals. I call

the reader's attention to this observation of Lamarck's, which, though it leaves a wide field to the research of observers, is not to be overlooked. 'Embryogeny, which successively reproduces the acquired characteristics in the same order in which they arose, definitely places the animals in their respective series.'¹ And these series continually overlap one another. Read what Edmond Perrier has to say about what elements go to make up the brain in the case of certain worms which are the ancestors of the vertebrates. When you have followed from the beginning the evolution of the cerebral organs throughout the animal series, together with its ensuing development of function, you will understand why metaphysicians find it difficult to introduce the demi-absolute which they call the 'soul' at any point along the line of embryogonical development.

To sum up: the genius of Lamarck was not inferior to that of Newton. It is well that these two great names should remain associated, for the two men, each in his own domain, most excellently paved the way for generalization. But one cannot separate the name of Darwin from that of Lamarck. Lamarck saw and formulated his vision; Darwin, generalizing only with the utmost caution, realized the vision, that is, by assembling established facts, patiently collected, he erected the sumptuous edifice the general plans of which had been drawn by his predecessor. No effort of patient ingenuity in a field of research which he indefinitely enlarged seemed to him superfluous if amid the most elusive shifts and turns of the infinite Cosmos he could thereby bring to light the highly delicate bonds which link together all individuals into one connected series. The value of his incomparable work must have been fully appreciated for Bible-ridden England to have thrown open to him the portals of Westminster Abbey. As for Lamarck, his remains were thrown into a pauper's grave — a fact which we may well ponder.

¹ Edmond Perrier.

III

PSYCHOLOGY, PSYCHIC EVOLUTION, BIOLOGY

By biological definition, psychic evolution should be, and can be, no more than an aspect of organic evolution. Obviously, this view cannot be made to meet the quibbles of a metaphysics hostile to science. On the other hand, a scientist is restricted by the results of research. Since in the development of our organic functions, such as every chapter of animal history reveals them, general evolution is but the synthesis of particular evolution, it implies classifications within which series of relationships are bound to progress.

By the same right and on the same basis as every other organic complexity, the evolution of the system which includes the brain, the spinal cord, and the nerve ganglia, inevitably determines the characteristic phases of mental development among animals.¹ Before the appearance of the nerve cell (neuron), together with the supplements necessary to make up a complex, we find at the start nothing except the simple direct reactions (reflexes) due to irritability or sensibility, until the complex activities of the phenomenon produce the characteristics of what is called the mental state.

We did not at first see the problem in that light. Artificially separated from the organic synthesis under the fallacious names of metaphysical creations, such as soul, spirit, instinct, the organic phenomenon of consciousness and of thought,² with all its emotional relationships, was led up the hopeless blind alley of the incomprehensible 'entity.' To-day, the evolution of mentality is a well-known fact.

¹ No one disputes that the evolution of the nerve ganglia in the insect allows it to a remarkable extent to fulfill a cogitative function (though its thought is, so to speak, pigeonholed), and that all living things manifest more or less conscious volitions. We see plants move with every appearance of intention, and this appearance prompts us to undertake the preliminaries of analysis.

² In ancient Sanscrit the word *Ma*, 'thought' (from which the word *Man*, 'the thinker,' is derived), means measure, that is, the definition of relationships.

But how can we deal with it, if it is to be considered as an intangible entity with no defined relation to organic coordinations? No one dares say that the immutable 'soul' evolves. Can we, then, conceive of any transforming action affecting the 'soul,' without being able to establish, or even so much as to imagine, any definite relation between the transforming agency and the soul which it is supposed to transform? The logical contradiction involved in such an idea leaves metaphysics no other resource than to ignore the problem.

Centuries have brought down to us, and we have preserved, classifications of so-called 'psychological' activities, from which any relation between the organ and the function has been systematically excluded. Biological research has nevertheless produced its inevitable results. The histology of the nerve centers — sense nerves and motor nerves, together with an initial disentangling of the methods by which they communicate — has allowed us to lay the first foundations of a science of psycho-physiology based on experiments.

I cannot dwell here on the more or less positively recognized activities of the nerve-world, or upon the associated reactions of conscious sensation and motility. I confine myself to the first appearance of sensation as a determining influence in the relations of the organs and the effects of mental action. What may now be stated is that in the successive stages of mental life identical functional relations at different stages of animal development attest an identical phenomenology in all animals, including man.

What happens to the fictitious entities of the metaphysicians? Comparative psychology was the result of spreading on the laboratory table organic exhibits scientifically and experimentally recorded. That day gave birth to scientific psychology, which is both the parent and the child of organic coordinations. That made it necessary to establish thinking man in his objective place in the series of creatures having a consciousness graded according to the disposition of organs common to them all and progressively

developed. In that domain of precise and suggestive definition from which the age-long effort of man has been to exclude the organ of thought, which he relegated to the realm of the supernatural, the law of evolution did not come into its own until comparison could no longer be avoided, not only among the inductively explained dead specimens of paleontology, but among complex organs in the active workings of their coördinations.

How many times in the course of these remarks have I not appealed for the institution of an experimental study of comparative psychology! Not that tasks of the kind I have in mind have been neglected. Germany, and especially America, possess an abundant literature in this field in which problems of every kind have been systematically attacked by observers who have not recoiled either from theories, or from precipitate interpretations. This criticism is not hostile. We cannot escape from the labyrinthian thickets of the jungle by Lenôtre's simple methods. Scientific observation of relationships is bound to triumph — but only after surmounting terrific difficulties!

An evolution of sensorial reflexes, revealed in the vegetable kingdom by the cell, and even in the mineral kingdom by the crystal, is manifested in the first linking-up of the primitive organs. Before, as after, the appearance of nerve-stuff and of the first sensitive and more or less conscious plasma, evolution followed its course up to the plexus formed by the cerebro-spinal system of thinking man. Clearly, since the death of Lamarck, we have gained no more than the first glimpses of the subject. We must none the less admire the prodigious effort of investigatory genius which already has permitted us to stake out the arduous path. Above all, we must divest our classic psychology of all metaphysics, for that psychology, too often imprisoned in realized abstractions, has, as I have already said, frequently prevailed, because it offered the path of least resistance. How many centuries of the most intense labor will it take to set up finally a positive science of mental evolution? By the same right as all other achievements of the experi-

mental method, comparative psychology will come into its own.¹

Psychology can be nothing but a branch of physiology, since the subject of its study is a function of organic sensibility from which, in spite of words, no one has ever been able to separate it. The chief difficulty which confronts metaphysicians is that, having committed the intellectual error of wanting to explain life by something superior to life, they are obliged to summon to their aid an order of phenomena outside the limits of phenomenology. We can only leave them in their inextricable embarrassment and, for ourselves, no matter what difficulty confronts us, we must never relax our firm hold on the cosmic chain which cannot be broken at any point in the universal activity. There, assuredly, lies the kernel of the whole problem. Do the co-ordinated activities of the Cosmos, to which we react through our sensorial reactions, inevitably follow one another, or, indeed, do we suddenly see some gap in the sequence through which some force exterior to the Cosmos can insert itself? Many persons strongly argue that such a gap exists, but since they apprehend nothing of that outside force except a vocable that represents a conjecture, they succeed merely in giving a false reality to words — a feat over which they make a great to-do!

Meanwhile, we continue modestly classifying phenomena which are observed, and the day is coming when all our objective guideposts will suggest to us formulæ of generalization which, when tested and corrected, we shall be obliged to accept as approximately correct. Just as metaphysical entities under the guise of words representing no objective reality resulted in nothing but the barren repetition of empty formulæ, so the experimental method has almost miraculously enlarged the circle of our knowledge, within which day by day the fogs of our misconception are lifting.

When, as the result of so many victories of scientific ob-

¹ On this point Sainte-Beuve has very justly remarked that 'the greatest adversary of Pascal in the eighteenth century, and the man who most successfully refuted him, was Buffon.'

servation, we have succeeded in coördinating the organisms of the living series, are we going to give up the method which has brought us such great success when we take up the study of the organs of sensibility? That would be impossible. That the cerebro-spinal organism, together with its plexus, controls the functioning of all the other organisms cannot be disputed. And if at the same time we reflect that it derives from them, and that brain, spinal-cord and ganglia do not lack the organic articulation that assures their union, how can we abruptly abandon the experimental method in the case of any particular organ? Should man, the whole of man, be placed in the ranks of the phenomena of organic life, that is, as a part of biological development? Or should we create especially for him a life of a composite order,—animal because of its organs, super-animal because of some undefined element,—an undertaking in which the finest minds have vainly exhausted themselves?

In that same undertaking, clumsy but well-intentioned people have been employed for thousands of years, but have never been able to do more than merely assert without verifying. The time should come, indeed seems to have come, when, having noted every organic analogy at every stage of the scale of life, courageous observers in an attempt to follow farther and farther back the path of evolution, will turn their attention to the indissoluble bonds which unite all the biological functions. Is it not obvious that the so-called psychological phenomena sink their roots into the very depths of our sensations, and that they are common to the whole series of living creatures which are organically akin to us? What could be more natural than that we should finally decide to undertake the organic study of man as an integral being? From that insatiable need resulted the first investigations of comparative psychology. Already its preliminary victories seem undisputed.

Comparative psychology is opposed by the most stubborn atavistic prejudice entrenched in such intangible words as 'instinct,' 'intelligence,' 'spirit,' 'soul,' etc., which, in a way permitting of no contradiction, deny in all the organisms

capable of showing sensorial reactions any relation between themselves and the phenomena of life. Imagination itself recoiled too long before the conception which seemed to call for an effort beyond the powers of a Copernicus, of a Galileo, or of a Newton. And yet, even where imagination recoils, the desire for knowledge may turn to observation. How many obscure investigators have silently endured their particularly thankless tasks, in order to make some preliminary contribution to the ultimate triumph of great reputations! Be brave, then, bold pioneer! You shall never know aught but the sufferings of effort; your highest recompense will lie in the fact that you have toiled.

As I write, we are only at the beginning. But our first steps have a decisive importance, inasmuch as they permit us to penetrate to those elemental activities the coördination of which produces the psychic action that has so long baffled us.

If we begin the study of psychic phenomena by an analysis of the abstraction, 'intelligence in itself,' amid the limitations of our own misconceptions, we can produce no better results than if we approached every organic function by reverting to the original physico-chemical activities which characterize the phenomena. We wonder to find how much our study is facilitated through the infinite gradation from the simple to the complex in every branch of biological activity. When we have been able to investigate even the explosion of the elements of the atom, how can we cry out at tropisms, which are the manifestations of the rhythm of universal energy set free by the action of gravitation? In connection with what has been currently written I am trying to explain how the reactions of a differential sensibility, the conjugations and combinations of which will find an echo in more or less differentiated organs, can spring from these tropisms.

We must regard it as established that our classifications of biological phenomena (necessarily subjective) must not be maintained against the universal coherence of the Cosmos which allows of no interruption at any point since, like all

other classifications, they are categories merely of cerebral action. The psychology of the organism is one manifestation of its physiology, and that in turn is a part of a biological whole subject to the determinism of universal cosmology. And when observation causes the subjective partitions which still seem to separate the mineral from the organic world to fall, the revolutions of the atom and the revolutions of the stars are found to be subject to the same laws. Conceived as links in the cosmic chain, comparative psychology, comparative physiology, and comparative biology, can, given the relativity of our knowledge, only mark different stages of our mental assimilation.

COSMIC RELATIONS

The first hints of a vague comparative psychology have long been observable. But in spite of the efforts of Locke, Condillac, Taine, and Ribot, our standard psychology is still so overgrown with metaphysical brushwood that it is very hard to provide guideposts with which to link up the cleared spaces of objective fact. There are as many individual 'faculties,' for the analysis of which we are offered only verbalism, as there are differentiated organisms. The ability to substitute words for facts is what endowed us with 'a faculty of intuition' (that is, a means of knowing independent of any contact with the exterior world) to explain whatever was inexplicable in our explanations, instead of following the individual steps of animal life and in that way detecting the relationship which exists among all common traits. And since the actual psychology of any organism endowed with sensibility can only be one chapter in its physiology, which is determined by its anatomy, the undertaking seems so extensive that we may well wonder whether we are not too presumptuous in attempting it.

The task, as a matter of fact, requires us to delve to the very foundations of the organic and inorganic activities of differentiated organs. At present we are merely on the edge of the subject. We have, however, some elements of objective knowledge, such as physiology and physico-

chemistry, which permit us to determine relationships¹ between one series and the other. That point the ordinary man has difficulty in accepting, because of the purely atavistic obstacle of passing from the mineral world, considered inert,² to the living world. We are, on the contrary, faced with a universal activity which, however it may vary in form, persistently maintains its identity. Once more let us take note of the fact that all our classifications are purely subjective. To recoil before appearances is simply to be frightened at an obstacle that we have imagined.

It is impossible correctly to interpret a single one of the phenomena of the universe if we do not approach it from the point of view of its evolution. In the day when evolutionary action was not known we were asked to consider the phenomenon *in itself*, that is, as something existing in isolation, outside the field of established relationships. Thus, words sufficed for the fictitious realization of a metaphysical entity by virtue of which every activity of the Cosmos was set in motion. When the fact was ascertained that scientific observation revealed to us nothing in the universe except coördinated relations, the entity had no longer any function in a world wholly composed of endless evolutionary cycles. It is more profitable to consider what we are told concerning the relation between the soul and the brain. De Bonald defines man as 'an intelligence served by organs.'³ What sense can the definition have if the intelligence is conceived as being preëxistent to the organs and outside the phenomenal world? If so, it would follow that we could in no way grasp the relations between the intelligence and the phenomenology of the serving organs. How can we explain the fact that in the case of the infant the introduction of the soul into the organism is at no point marked by any observed phenomenon, whereas from birth to maturity we can see the successive evolutionary stages

¹ Cf. the kinetic theory of gases, liquids, and solids.

² The theory of the inertia of matter, with which mathematics cannot dispense, is necessarily the result of equilibrated energies.

³ The writer dares not say '*dis*served,' but obviously he thinks it.

which the newborn child traverses in passing from a purely animal condition to the first manifestations of thought?

As long as, in the attempt to get to the heart of elemental activities, the psychic phenomenon was regarded as an absolute which served as the starting point of an investigation of which imagination was the instrument, nothing could result except verbal ingenuities into which the entity 'soul' was introduced haphazard. Every one knows what Plato, whose ideas were reconsidered and brought to perfection by the Alexandrian school, made of the matter. Nothing can be derived from his teachings except formulæ for academic exercises. How could it be otherwise, since what we call the intelligence is merely a point in organic evolution which results from the successive reactions of sensibility, according to forces the composition of which remains to be determined?

If we consider human intelligence, whether of yesterday or of to-day, and if we try to relate it to the universe before we have learned what are the elemental activities of the universe itself, what can result from such an idle investigation but a total confusion of words and ideas? But if, consenting finally to consider the solar universe (organic and inorganic) in its entirety, from the nebula to the sun, then from the sun to the blazing and later cooling planet, we seek patiently to trace back the course of the successive stages of its evolution, of which so many positive proofs lie before our eyes, we can then discern the light cast upon cosmic development by verified experiment.

Indeed, the organic world must be inseparably connected with the inorganic, since we see our earth in cooling pass from a state universally mineral to transient states of organization which give definite form to the reactions of irritability and of sensibility. It should not surprise us if the forms of that sensibility continue to determine one another, for thus the law of evolution is being accomplished. Radio-active atoms and the kinetics of elements reveal to us aspects of the universal activity in which physics and chemistry distinguish heat, electricity, magnetism, light,

etc. — phenomena which may perhaps be summed up as phenomena of attraction¹ according with the rhythms of the universe. In those different forms, cosmic energy reveals itself to our sensorial surfaces, which themselves are merely an instance of the universal sensibility.

The simple electrical reaction of iron when in contact with the hand seems clearly to reveal a mineral sensibility. In the same way the incessant sensitive reactions of the atom, of its electrons, of its ions, etc., are proved to be identical with the reactions of the stars in their revolutions. Thus, when we least thought to find it, we hit upon the bond which unites the activities of the elements with the activities of the stars. Established by experimental methods, the interdependence of all parts of the Cosmos, even when beyond the reach of our instruments, is, we find, settled beyond all debate. All that remains is to determine the cycles into which the successive rhythms of evolutionary action, without beginning or end, are resolved.

In the mineral order, improperly called 'inorganic,' the successive organic complexes continue in logical sequence according to the general law of individuation until they develop forms of united and coöperating activity. The crystal is one of those manifestations so obvious that it cannot escape our interpretation. It necessarily marks one of the innumerable stages of the innumerable processes of evolution which by incessant transitions lead from the so-called mineral to the so-called organic state. To us a crystal is merely a landmark in evolution which has been preceded by an indefinite number of others, of which, up to the present, we have been ignorant.

Crystallization is one of the most striking manifestations of the phenomena of individuation, which, like all other phenomena, is brought about by the development of differentiated attractions. A solid crystal, like a liquid crystal, which suggests organic plasma, is a preliminary stage of individuation. It has an Ego distinct from that of its

¹ It is an interesting question whether repulsion is not simply the manifestation of an attraction of opposite sign.

congeners. Its characteristic is that when injured it heals itself along the lines that govern its being, exactly like any living organism. Therein lies preëminently the determining phenomenon of individuality, since the laws that gave it its elementary state tend to preserve it in that state instead of giving it a fixed form, amid a profusion of juxtaposed units of the same sort. In that fact we detect in the mineral world the basic characteristic of the 'living' world, namely, a characteristic which attests the effort to maintain the organism as constituted.

Now our task is to trace the transition from the individuation of the crystal to the individuation of the cell — it being understood that there is between the two a series of stages, either convergent or divergent, which we cannot detect. The fact is that our intelligence, capable of detecting only the shifting of relations, jumps from phenomenon to phenomenon. The implication is that in the activities it detects there are correlations of which it receives the sensation through a succession of fugitive shocks, the interconnection of which it infers. Are there other 'mineral' individuations than that of the crystal? The existence of 'liquid crystals' is a sufficient reply. We can neither measure nor number the metamorphoses of the universe. How many other developments of individuation¹ may we not assume to exist through colloidal action?

A crystal is a mass which to an untrained eye seems unalterable, but which is, nevertheless, a mass of organized energies. Of those interior activities all that we can at present say is that they tend to individualize themselves permanently, since in the case of an injury or of a break in the general construction they reëstablish their morphological unity along the established lines. It is the visible reaction of an individual sensibility, the manifestation of which cannot fail to be recognized for what it is. Doubt-

¹ I have already pointed out that in the mineral mass concave lines have been recognized which may indicate the initial tendency toward a cellular formation. On an earlier page I have also shown that with the aid of a simple mineral solution we can see the formation of an osmotic membrane.

less there are many others. At least let us grasp this one.

The peculiarity of the cell is that physico-chemical solidification, instead of occurring in the mass, takes place in a concave membranous surface which, being permeable by osmosis, permits full reciprocal action, whether assimilating or disassimilating, between the individual and the environment.

As the reactions transferred from the so-called physico-chemical order to the so-called organic order bear witness, elementary sensibility will necessarily increase according to the degree of development of individuation from the mineral to the cell. We see the beginnings in the mono-cellular amœbæ, minute floating vesicles which when in the neighborhood of their prey change their shape, only to resume their original form after they have assimilated it. To-day, scientists regard that action as the effect of a tropism, or, if you prefer, of automatic reflex action.

In a certain sense the amœba may be said to make a 'choice,' that is, it performs an act identical with the act which in our own case we designate by the terms consciousness, intelligence, and will. But that act, which is physico-chemical in origin, has no more than a rudimentary character at the border of the organic world.¹ Meanwhile, one often hears of the first appearance of instinct, or even of will. First and foremost, we must agree on the meaning of words. One fact which cannot be contradicted is that primitive sensibility admittedly ends in muscular reactions. In that phenomenon I can see only a question of degree.

If we pass from the phenomena of mineral sensibility to

¹ Le Dantec does not admit that the amœba makes a 'choice' in the sense in which we understand the word. He sees it as exclusively the physico-chemical effect of the aquatic environment on the colloid of the protoplasm. And that description seems to him to apply as well to the mono-cellular animal as to the aggregations of atomic elements of which every organism is composed. Since life is 'an aquatic phenomenon,' each cell of our organs behaves like the amœba in the environment, in the state of colloidal protoplasm from which it derives its substance. He claims that it is alternate assimilation and disassimilation, which, acting in opposition, vary the reciprocal reactions between organ and environment which go to make up life. *Éléments de philosophie biologique.*

those of vegetable or animal sensibility, how are we to determine at what moment some degree of consciousness may appear? All cosmic phenomena assume an infinity of transitional forms. The phenomenon which we briefly describe as consciousness seems to us the unfolding of an individual sensibility. At what point in the biological series can the sum of sensorial reaction attain sufficient tension to justify the name of consciousness, with its attendant reactions of will? We have made much progress when we have asked ourselves that question.

Brought to the point of distinguishing between intelligence and will among the various members of the animal series, we have tried to reduce them to the very minimum of sensory reaction under the name of instinct — a procedure the principal advantage of which is that it does away with the need of definitions. From that evasive position, even metaphysics is being driven. As a matter of fact, we find in the organic world nothing but an infinite chain of sensory reactions, running from the sensory reflex which leaves no trace in the memory of the organs, to the complex sensorial activities which determine that individualizing of relationships which we classify under the names of consciousness, intelligence and will — a chain from which nothing can escape except by the trick of using a word which represents no reality.

I have mentioned how that obstacle arose from the necessity under which our ancestors found themselves of designating by a vocable a group of phenomena which they could not analyze. Confronted with a word, to what could they relate it, if not to some activity no sooner designated than made real? And, when the proof of tested observation came, they naturally preferred to explain the thing in question as an entity rather than to accept the intricacies of organic evolution. The masses so easily adopt a pretentious but meaningless name! Words in this case do the work of x in an algebraic equation, but with this capital difference, that x openly stands for an unknown quantity, whereas words — life, intelligence, thought, — have the appearance

of solutions, — an appearance sufficient to win acceptance from the common run.

However, our efforts to know leave us no leisure. To prejudge psychic phenomena, of which dogmatism assumes full charge with the idea of forcing the unquestioning acceptance of solutions made for the use of those for whom talking is the same as thinking, is too easy. We have, to be sure, taken pains to set aside the words 'sensibility,' 'consciousness' and 'thought' to designate the higher psychic manifestations of which Descartes gave us the monopoly — as if our verbal classifications could change anything in the natural order of things, which knows no divisions! But after the collapse of the Cartesian mechanistic theory, what remains of this inexcusable error? Does there not appear in the animal series a definite psychology, even before the appearance of the organ in which the potentiality of the phenomenon is to be concentrated? That is a fact which Lamarck has clearly stated in express terms: 'If the highest forms of psychic endowment require the presence of a nervous system and the grouping of nervous cells, it does not follow that the lowest forms cannot develop where there are neither associated nervous cells, nor even any nervous system.'

And Betcherew says: 'The simplest organisms reveal a choice which does not depend on their movements. That independent choice has its origin in the internal elaboration of external excitations. We are forced, therefore, to admit that in spite of the absence of a nervous system, those organisms have a psychic activity, however elementary. Their lack of a nervous system does not have in our eyes any essential bearing on the question that we are considering. Cannot the absence of any muscular system among the infusoria serve as a pretext for denying their faculty of moving? Does not the absence among them of any stomach argue in favor of their having no ability to digest? And yet well-attested observations tell us that the facts are absolutely the reverse. Psychic functions are as inseparable from the plasma as are any other biological functions. . . .

There is no reason to believe that in the animal series the manifestations of energy must absolutely be bound up with any nervous system . . . which merely constitutes a center especially set apart for the manifestation of energy.'¹

In other words, mental evolution, resulting in our actual psychic state, shows the evolution of activities that before progressively concentrating in distinct organs imply an original energy (from which springs the organ) diffused and developed in the mass, like every other form of cosmic energy, until individuation occurs. To be convinced, we need only observe the daily evolution of the newborn child from the first automatic reactions of its organism to the marks of a progressively defined consciousness.

The worst errors, the effects of which have been so disastrous for the development of our intellect, consist in wishing to define the infinite Cosmos in terms of human subjectivity, which is a merely momentary individuation. A barricade of realized abstractions blocks our path and makes it impossible for us to grasp the idea of limitless and unceasing action — action to which the words which are necessary to our assimilation of relationship have the drawback of seeming to set bounds. Seeking something which will give reality to our abstractions, we are reduced to contriving entities which lie outside the phenomena of which we seek to make them an integral part. When we pass from the first manifestations of sensibility in the mineral kingdom, which are organically developed in the vegetable and in the animal kingdom, in order to arrive at sensations associated or dissociated by language we can establish points of relationship, whereas the 'immortal soul,' ambitious in a quite different way, pompously promises us something comparable to the absolute.

By our own fiat and within the limits of our own subjectivity we established a mineral, a vegetable, and even an animal 'kingdom.' Later, through increased knowledge, we were forced (in spite of the 'immortal soul') to fuse the human kingdom with the animal, and soon afterwards we

¹ Georges Bohn: *La Naissance de l'intelligence*.

were obliged by the similarities in elementary organization to unite that with the vegetable kingdom. Finally, in the mineral kingdom, which until now has maintained its isolation, there have already been discovered physico-chemical activities, as the inevitable preliminaries of the so-called 'organic' form. When we examine the correlation of these phenomena, their very nature requires that our principal difficulty should be to find the point at which to change their names. Actually, no such point exists. It is merely a requirement of our mental organism which, on account of a verbal act necessary to articulate language, must temporarily determine the associations of images which constitute thought.

I have already cited the example of the sprouting potato, which seeks the light of the cellar window and finds it as surely, to use the phrase of Claude Bernard, 'as any intelligence would find it.' What is that example but a phenomenon of vegetable life which we explain through the action of light, necessarily followed by rudimental proliferation? The *Cymbalaria linaria* acts in the same fashion. In that case the stem, as soon as its seeds are ripe, folds back upon itself in order to insert them in the crannies of the wall. That constitutes a tropism. It is a geo-tropism following a helio-tropism, both clearly defined. And what is the origin of the tropism itself if not the physico-chemical reactions of universal energy in the form of so-called light, heat, electricity, magnetism, etc.?

Here, then, on the statement of a scientist who makes no pretense of philosophy, we have a group of physico-chemical phenomena producing results identical with those which 'intelligence' and 'will' produce. Is not that matter for reflection? It is only too easy to explain why before we knew either physics or chemistry, and before we could in any degree understand the manifestations of cosmic energy, we summed up our sensations in words, the special value of which lay precisely in the element of the unknown which they contained. Yet, when through the efforts of scientific observation the element of the unknown enters into the do-

main of the known must we not proceed from the known to the unknown instead of beginning with what we are pleased to term the 'knowledge of the unknown'? When it is proved that the effect of what we call 'intelligence' occurs in organisms in which we do not expect it, is it not well to reverse our method of investigation and to start at the simple in order to arrive at the complex? Only thus can we grasp the relation of phenomena and establish a sum of knowledge, doubtless incomplete, since we are called upon to confront the infinite Cosmos with our own relativity, but still sufficiently complete to keep us from going contrary to the procedures which make the universe accessible to our methods of understanding.

Of that fact modern science has finally taken note. Jacques Loeb in his laboratory in California; Bouvier through his work on '*La Vie psychique des insectes*'; Georges Bohn through his '*Naissance de l'intelligence*' and his '*Nouvelle psychologie animale*,' have boldly entered this field. They have succeeded in establishing phenomenological alignments which permit us to trace psychic evolution from the original activities of inferior organisms. It is the beginning of a comparative psychology, a division of physiology and of comparative biology. As yet we cannot have access to the organic reactions of sensibility independently of the conditions of general structure which characterize the living organisms. It outlines the problem and its preliminary complexities.

Our age-old terms of psychic phenomenology have always had a tendency to exalt man above the rest of living things, as if he were the autocrat of a people whose life was not of the same nature as his own. Men began by creating under the name of 'instinct' a sub-intelligence, on which devolved the function of regulating the primary reactions of animal sensibility. They always followed the same method: first of all, they adopted a word for the purpose of isolating the phenomenon divorced from all its relationships. As fast as elements of coördination appeared, the champions of instinct held all the more obstinately to their idea, because

the word supplied them with too convenient a method of explaining everything. One more division in the indivisible objectivity of things, it will endure a long time yet. The reactions of infusoria, closely analogous to the reactions of vegetables, indicate states of sensibility so like those of other living creatures that observation might rather tend to confound them — in spite of the fact that we have expended the liveliest part of our imagination in order to differentiate them.

PRELIMINARIES OF A COMPARATIVE PSYCHOLOGY

Of course we have long been showered with every variation of the theme of the intelligence of animals.¹ No attempt at explanation was made, and nothing resulted except a severe shock to our theory of the human soul, which was supposed to be the only vehicle for thought. For the preservation of life through alimentation, for the satisfaction of all the needs that follow upon it,² for seeking pleasure and avoiding pain, for reproduction with all the resulting arrangements for family defense, the animal has at his disposition precious resources, shown by coördinated sensations which produce the results attained by 'intelligence' — resources which Descartes thrusts aside as 'mechanistic,' and which observation exalts as being most characteristically psychic.

Men long expatiated on the manifestations of animal intelligence,³ and Darwin, without exhausting the matter,

¹ Especially of the higher animals, notably mammals and birds, as well as those insects which have a ganglionic nervous system.

² Including all methods of defense against the appetite of enemies.

³ I cannot linger over the question of organic relationships, which is a never-ending subject. To-day it is admitted that the ascidian is akin to the very first ancestor of the vertebrates, the most ancient representative of which seems to be the amphioxus. That fish, formerly classed among the worms, is remarkable for its negative characteristics. 'One can hardly say,' writes Darwin, 'that it has a brain, a spinal column, or a heart.' We know the genealogy of the chordata, the most numerous and highest representatives of which are the vertebrates. In them the central nervous system consists of a concave dorsal cord which extends lengthwise from one end of the body to the other above the digestive tube. Above the nervous axis and between it and the digestive tube stretches a second cord, which is not concave but full, and which serves as a support. It is

has perhaps sometimes exaggerated. What surprises were contained in those fragmentary mental complexities, the manifestations of which are all the more marvelous in that they formally contradict what we have been taught of the cogitative privilege of the 'human soul,' and reveal ties between ourselves and the animals hitherto dogmatically denied.

It would be superfluous to linger over the obvious evidences of intelligence among animals. Every one can expatiate without end on the theme without as a general thing venturing on any strict conclusions. The reason that we derive nothing from our discoveries about the intelligence of beasts is that we relate our own intellectual manifestations to those of the animals instead of relating the psychic manifestations of the animals to those of man in the evolutionary sequence. That procedure is easily explained. But if some part of man resides in the beast, the reason is that the beast has previously given to man all that it could of itself.

The elephant has such a high reputation for intelligence that I hoped much from getting acquainted with him.¹ To begin with, in the museum at Colombo I had seen a brain disproportionately small. The sharp gimlet of a minute yellow eye seemed to me hard to interpret. But Hathi and his mahout have a fame so well established that I had made up my mind to admire everything about them. When I saw the crude trap of stakes set in a circle where the monstrous beast stupidly lets itself be led by an enslaved comrade, I denied it even the most ordinary judgment — especially when it lets its leg be tied for a final punishment which the least gesture of defense would prevent. When they told me at Ceylon that a domesticated elephant sent to lead a wild herd into the snare had decided to stay in the jungle, I held

called the dorsal cord. This cord constitutes the primordial axis, and around it, in the imminent evolution, the spinal column was to form in anticipation of the swelling that was to become the brain.

¹ Every one knows that the Asian elephant is easily domesticated, and that the African elephant is ill-adapted to civilization, and that it will not even permit familiar approach.

it in high esteem, and I even liked the animal when it resumed its chains at the summons of the familiar song which its friend, the mahout, sang from the top of a tree. At Lahore I hated the brute for stupidly entangling my head in the electric wires. In the jungle at Mysore I was lost in admiration of the elephant when, while we were hunting buffaloes, it pushed to right and left and even broke above my head all the branches that might hit me. Afterwards, my only remaining resource was pity when I learned that all these attentions were simply the result of the mahout's striking the beast with his heels under the ears and thus obtaining for me, mechanically, by way of reflex action the favors that I had thought I owed to friendly feeling. A few days later, while fishing in the Caravani, a beautiful, turbulent river flowing through the jungle of Mysore, we saw coming towards us a troop of perhaps thirty wild elephants which, at a distance of less than a hundred meters, scattered over a sandy beach to bathe, sport with their little ones, play every kind of trick on one another, and copiously spray themselves with water. At an imperceptible signal they all went away together. Then the voice of the leader rang out, and the troop suddenly returned to its thickets without having done us the honor of making our acquaintance, an honor which we prudently refrained from seeking.¹ Creatures of sharply defined mental gifts would on the first impulse have either taken to flight or reduced us to pulp. After all, the elephant is no more than a late survival of the age of monsters, when the rule of muscle and the power it gives settled every account in life until the dawn of that distant day when intelligence, whether wandering in error or brought into the right path, was to bring man face to face with the Cosmos.

Every man who lives on familiar terms with a dog or with a cat so naturally identifies its sensorial associations with

¹ The elephant is also subject to accesses of fury and to inexplicable antipathies in which the primitive brute suddenly reappears. I was told of a case in which a female elephant had to be shot because she had suddenly taken an aversion to one of the travelers who had been confided to her care.

his own that the two enter into each other's feelings and understand each other at the least sign. The procedure in each case is the same; only the degree of evolution is different. My dog is used to my habits and his are known to me. They flow harmoniously together except when authority interrupts them — an interruption that is to be imputed to me rather than to him.

When the trunks are brought out, my little Scotch terrier, not knowing whether he is to go along, is downcast; then he sets about looking for signs from which he can guess what is to occur. He cuddles up to me, seeking the friendliness from which he can conclude that he is not to be left behind. I have often observed that my answer never deceives him. Repulsed, he knows what the action means and falls again into his original depression. Welcomed, encouraged by voice or gesture, he knows that fortune smiles, and he bustles about the baggage and shows his joy when we leave Paris. The idea of returning there is so unpleasant to him that we have to put him into the carriage. In his case, as in ours, intelligence and feeling are in close association. My pointer bitch, arriving one morning at Paris, was lost on the boulevard Haussmann. I lived in the rue Montaigne. It occurred to me to retrace the trip, following the sidewalks I had passed over. At the Penthievre barracks I found my dog, returning home, very slowly, and sniffing at the walls. My bull-terrier often rode in cabs with me. One day, when lost in the Champs-Élysées, he jumped into a cab; the driver brought him to me after reading the address on the collar. My father told me of a dog who always knew when it was Friday, which was market-day in the village, and who went to hunt up the cook if she were late. My Aberdeen, who attentively follows my gymnastic lesson every morning, does not disturb himself on Sunday, knowing that the instructor does not come. I must admit, however, that holidays fool him.¹ But I could go on indefi-

¹ This year Easter comes unusually late. In spite of the bad weather, the trees have begun to bud, and my travel-loving dog, to whom I had not confided that proofs to correct were delaying my departure, keeps coming to my table and barking to get me to start.

nity. Through their close relationships, the progressive degrees of emotional susceptibility govern and determine the activities of the intelligence. Throughout the whole animal series the stages of mental development rise to a higher plane step by step according to their degree, but everywhere and always develop in the same way. And, indeed, the reverse is what should astonish us. On this subject of investigation, in conjunction with the reaction of vegetable sensibility, Darwin, from his own observation, supplies us with stories of incidents of animal sensibility no less marvelous than the most poetic legends. What would not people have said of them, had they not had the serious drawback of being true?

The manifestations of sensibility, with all their consequent reactions, extend in different degrees of completeness through the whole range of the living series by the same title and under the same conditions as do other organic manifestations. Indeed, it would be impossible that they should not be coördinated. And the wonder of wonders is that we are obliged to supply scientific proof of the universal linking together of things under the anathemas of the high priests of hallucination. Furthermore, animals often illustrate even the most profound emotions of humanity. My bull-terrier having killed his comrade in a dispute over a bone, the offender, though not waiting to appear before any criminal court, remained for three days hanging his head in a corner, manifesting signs of regret and perhaps of remorse. What can be expected from similar organs except similar reactions?

What does the amusement of a mother-dog, watching her puppies at play, suggest if not the inevitable comparison? Play is a gymnastic exercise which through 'Lamarckian habit' brings about an evolutionary advance. All young creatures play as an apprenticeship to life. But play has its rules, its unquestioned basis of intelligence and feeling, without which it would be as senseless as the convulsions of an epileptic. No one teaches those conventions to the young animals, who simply follow the impulses of the coördinate

workings of their organs. But, because those organs are of the same nature as our own, their activities inevitably produce the same effects.

Except for the fiction of the doll there is, indeed, but a single game: fighting in various forms, skillfully measured and attenuated. It is a preliminary to the day when no consideration shall any longer be shown in the great battle of each against all for his place in the sun. Consider with what eagerness, without a trace of previous instruction, young animals (children included) engage in sham battles. The small claws and the little canine teeth are very careful not to press too strongly, but they do press all the same, and the mimicry of the sweeping paw and the biting tooth is present in a superlative degree. The little beasts jostle one another, roll one another over, and utter cries of fury, and the mother herself sometimes takes a share in the sport. How does the case of our children differ, except in a greater readiness to go too far? *Jeux de mains, jeux de vilains*. The monkeys of Muttra, who nimbly play on the steps leading down to the river with the clumsy turtles lured there by the handfuls of rice tossed by the traveler, can neither do harm nor receive it, whence perhaps the friendliness that both evince. How can we fail to recognize that the agreement between the spontaneously coördinated activities in man and in animals calls for a strict correspondence in emotional and mental make-up in which the natural community of organs and functions becomes apparent?

A little girl endows her doll with life, and a little boy considers his rocking-horse alive. In each case it is a sort of training for a future of which they are vaguely aware. The less ambitious kitten needs only a ball of yarn to represent a mouse. Consider its attitudes: the ambushade, the pounce on the enemy, the blow of the paw that puts him to flight, the leap that captures him. When the kitten has become a cat, it will repeat the play when it captures a living mouse, no longer as a convention of the imagination, but with all the cruel joy of savage reality.

Like ourselves, the cat is not always idealistic in its rela-

tions with the weak. Under our strong hand it is all gentleness, all childlike sweetness. Let it be tempted to abuse its strength, and its feline cruelty returns, as in the case of the man who invented the pastime of the chase as a recreation in which the tortured victim foots the bill. Unable to complicate its sport as we do by interposing dogs between itself and its prey, the cat passes instantaneously from human caresses to the barbarous pleasure it derives from the physical and moral torment which it ingeniously combines to protract the agony. The Inquisition in its torture chambers where the name of Christian charity alternated with the tools of the executioner, made those under the censure of the Church pass, always in the interests of their salvation, through the whole gamut of convulsive earthly suffering, aggravated by an eternity of torment in hell.

By a singular grace the cat, a simple carnivore, does not carry things so far. It holds a little living mouse, whose heart is beating violently, and the dark gleam of whose little round eyes reveals the terror of expectancy. The torturer holds the weak life in its sharp claws, and for the sake of the amusement that is to follow carefully makes its victim merely feel their points. It is a supreme pleasure to inflict pain and economically to protract it. The trembling little animal keeps still, and the cat, very demure and turning its eyes elsewhere, seems to meditate deeply. The victim may think that it is forgotten. But let it try a lead toward safety, and the bloody paw will send it rolling head over heels. Wounded, it tries another move, and, surprised that the cat makes no counter-thrust, it dreams that there is a chance for safety. Very unobtrusively it turns toward some near-by hole. The cat does not interfere, for it is the end of the game, and with a bored air indifferently gazes into space. Should the tortured animal let itself be caught anew, it is lost, for the reaction of the pounce will be proportionate to the distance traveled. It is a contest of wits between the executioner and his victim. If the mouse seems to give up the idea of escape, the cat is no longer amused and with a light and velvet paw seeks to renew its fright. To

encourage the victim, it will go so far as to concentrate its attention elsewhere. One day I saw the mouse escape, only too happy to die of its wounds in peace.

So nature plays. Claws are no less sharp than teeth. Play enters into the game only when the animal is serving his apprenticeship to life. Deceptive appearances cloak basic ferocity. The only act of Providence to which we fail to give due appreciation is that ultimately it allows death to bury this multitude of ills in forgetfulness.¹

The necessity of settling the sequence of the general and particular phenomena of biology could not help but throw light on the other organic developments of the animal. As soon as the functional relationships in the living series were recognized, our means of scientific investigation were remarkably enlarged.

But where shall we start and how shall we know where

¹ Sometimes the weak in their forgetfulness unconsciously visit retribution as a sort of philosophic revenge on the strong. Osman Digna one day taught me that truth. As lieutenant-general of the Mahdi, he was one of the great men of the world. Guilty of every crime, he had brilliantly led hordes of blood-thirsty fanatics against the English in the Sudan. I went to see him at Wadi-Halfa where he is still held prisoner against all the laws of war, but perhaps to his own advantage, for so many unsatisfied vengeance hang over his head that at his first free step he would fall under the sword. I found him asleep on a bundle of straw in a prison that lacked bolts, and when awakened, he came towards me with hand outstretched and with a volley of words by way of friendly welcome. He was a large man and old, with a fine white beard, piercing eyes, and the expansive smile of the visionary. He passes his time in sleep, or sitting motionless in the sun and reciting verses from the Koran. One day, the officer to whom he had given so much trouble came to pay him a call. To be precise, it was his conqueror, Kitchener. The two men shook hands cordially, and the Englishman waited for some reminiscences of bygone times. Silence. The polite smile was there, but of words there were none.

'Don't you recognize me?' was the natural question.

'No.'

'I am Kitchener.'

'Ah!'

'You don't remember? Kitchener?'

'No.'

And the victor departed, put out of countenance at having left in the mind of his adversary not even a memory of a name in the extinct rancor of the conquered. The incident serves to put in their place in the history of the world those brilliant feats of arms which from a cosmic point of view are not much more than the play of cats and mice.

we are in the thick undergrowth in which the transition from the inorganic to the organic is hidden — a transition glimpsed rather than distinctly seen. The task is most difficult. Always we encounter that notorious primary spark of life concerning which our phenomenological nomenclature so constantly leads us astray. Everywhere we meet those formidable boundaries, with their 'impassable' barriers, which separate physics and biological chemistry. I fully agree that these classifications are indispensable, since the aim of our knowledge is to classify the variations of relationships. But those very classifications of series are obviously dependent on the state of our knowledge, which, every day increasing, bursts the old subjective forms to shape new ones which tally more closely with reality.

Must, then, the transition from the inorganic to the organic be obstructed by an impassable barrier, of which the metaphysician before he uses it to frighten us will continue to be the original victim? Where shall we find the dividing line when, as a matter of fact, we see it recede as our knowledge increases? What individual cosmic activity can be segregated from the whole, without introducing an incoherence destructive of our universe just when all the activities of the world seem to become identical, as is now recognized in the case of light and electricity?

And yet, what transitions remain unrevealed in the strictest definition of what we term phenomena! The unity of universal energy seems more and more authoritatively convincing — synthesized in an integral phenomenon, which our analysis dissects, in order to assimilate as much of it as we can. Every phenomenon, in the sense in which we understand the word, is a complex of other phenomena of corresponding formation. If we could objectify all the relationships of things, our subjectivity would no longer have any elements with which to start work. Knowing everything, and sharing in the life of everything, our vague personality, lacking definition and outline, would be dissipated in an abyss of nothingness.

Our lot is very different. Being merely a particle of the

infinite—a moment of individuation in opposition to others—we can record the transitions of things at the price of inconsistent efforts which too often do not put our knowledge on a stable basis until after it has passed through various stages of error. Can we not yet make the best of those inevitable misinterpretations to which the original forms of language committed us? However, the law of our evolution does not permit us to remain longer in the matrix of primitive error. And since the capital mistake that qualified the help we derived from the verbal mechanism we created was, and still remains, mistaking words for things, let us, before we allow ourselves to be embarrassed by the word life, inquire what varieties of organic evolution should be grouped under the head of comparative biology.

Since animals, like ourselves, are subject to evolution, it must follow that their minds evolve for the same reasons and under the same conditions, if not at the same rate, as do our own. The inferior field of sensation cultivated by animals, which results in a less active intelligence, necessitates a lessened power of evolution. Evolution is potential in them none the less. We can rarely compare examples of skeletons of the same animal species, differentiated according to the successive periods in which their owners lived. Nevertheless, when ganoid fishes become fishes with scales, we are sure that in the organism as a whole, there has taken place a decisive transformation in which the changes of the sensory apparatus, which is on the borderline of cerebration, cannot be neglected. The same thing must necessarily be true of all the successive stages of animal life.

If we had been able to set up landmarks in the mental evolutions of the animal as we have begun to do in the case of man, we should be in a position to establish some interesting facts. If the fox and the wolf learn day by day to pursue their prey better, that prey, on the other hand, grows more skilled (through Lamarckian habit) in feints that sometimes permit it to escape. In different degrees, the progress in skill may vary according to racial or individual aptitudes. Variable again in the highest degree both in the

race and in the individual are the possibilities of the hereditary fixation of those variations. Should the evolution of either the pursuer or of the pursued give it too great an advantage, the other would disappear and would be replaced by creatures better equipped, whether for attack or for defense. The general aspect of the world would not be materially altered.

Under the title, 'La Naissance de l'intelligence,' Georges Bohn has published a volume which summarizes the principal present-day views of comparative psychology.

Réaumur's remarkable researches into the life of bees began a laborious undertaking. Georges Leroy soon afterwards resolutely entered upon the task with his 'Lettres philosophiques sur l'intelligence et la perfectibilité des animaux.' Frédéric Cuvier followed Leroy, when on his authority he conceded that orang-outangs had the ability to generalize. In those days the question of the observation, or even of the hypotheses of an ascension in the line of animal forms culminating in the evolution of man had not been raised.

At this point again the mastery of Lamarck becomes strikingly apparent, and to him Bohn frankly gives due credit. From the beginning Lamarck had with a sure hand traced the evolution of the nervous system in the animal series. I do not undertake to determine with any precision at what point intelligence and will begin; I am convinced that the question is predominantly one of words. If by a definite act of choice the amoeba distorts itself in order to reach its prey, I do not believe that science denies it the attribute of 'will.' If I do not use the word to characterize the actions of plants, it is because general usage does not sanction it and attaches less importance to similarities than it does to differences, which are always conspicuous.

Sensory reactions, which are inherently physico-chemical, originate in motility and are as obvious in the case of the atom as in that of the stars, which are sensitive to the interaction among all the sidereal masses, however distributed. That is the important point in our scientific explanation of

the phenomena of life. As we have seen, our verbal classifications may be productive at once of knowledge and of misconception. 'In certain of the inferior animals the exciting cause of movement comes solely from outside itself . . .'¹ that is, from its environment. How could it be otherwise, when organ and environment are everywhere in a condition of interdependence through the incessant reciprocal action between the environment and the individual? In the case of man, the process is no different, in spite of the intervention of that coöperation of organs which conditions the phenomenon called 'will.'

When by a change of place the unicellular animal reacts to the effect of light, or of the moving planetary mass (photo-tropism, or geo-tropism) it is always the action of the environment which solicits the reaction of the organ and obtains it. To classify the phenomenon under the name of tropism seems to me to be a correct start towards an interpretation the aim of which is to indicate the attraction of living things by energies exterior to them, for there we touch, it seems, the origin of sensibility, that is, the chance rhythms of the development of every kind of activity.

Perhaps it is an over fine distinction to say that 'the vegetables and the polyps do not see, although they turn in the direction from which the light comes,' or, again, that they are not endowed with 'consciousness.' Since they react to exterior stimuli, it must be that there are points of junction between the displays of sensibility in the organic series, and the physico-chemical reactions which engender them. Loeb wisely remarks that 'scientific biology began with the investigation that Lavoisier and Laplace undertook (1780), in order to see whether the quantity of heat developed in the body of a warm-blooded animal is the same as that which a candle produces, since the quantity of gas formed is the same in both cases.'²

Arrhenius's hypothesis of panspermia, which assumes that minute germs could be projected into space by the pressure of radiation until they met conditions favorable to

¹ Lamarck.

² J. Loeb: *The Mechanistic Conception of Life*.

their development, is not one to be discarded, even though it does not suffice to explain the appearance or even the propagation of life. Every one is familiar with the able work of Loeb and of his followers on the fertilization of the egg and on germination. Life is oxidation. The increase and the decrease of oxidation are the two piers of the bridge between life and death.

The linking together of all phenomena is the basis of our knowledge. If our relative capacity necessarily brings us to a stop somewhere in the process of penetrating certain relationships of the infinite universe, our inductions from experiment nevertheless permit us sometimes to catch a glimpse, by the light of hypothesis, of what is beyond the horizon. This happened in the case of the atom and will probably happen in the case of the ether. When Lamarck wrote that the nervous system is a sort of accumulator of the forces of the environment which it transforms, he did no more than characterize the evidence of the phenomena in which under the operation of sensibility the activities of man converge.

Nothing better shows to what extent the exterior world and the inner world of the organ are connected than the decisive experiments in artificial parthenogenesis whereby Loeb and Delage demonstrated the chemical and even the physical excitation of the ovule which results in the physiological phenomenon of reproduction.

Experimental parthenogenesis, stating the problem under different forms, ended in emphasizing more and more strongly the influence of physico-chemical elements in biological phenomena. Hence the great recognition granted to the work of Loeb and of Delage, for it is necessarily at the beginning that the question of the entity's appearance arises. And it is at that point that, through modification after modification, mineralogical evolution will disclose the formation of new types of life engendered by the inorganic in the organic. The first physico-chemical reactions of the cell and of the plasma which started embryonic life were decisive on this point, especially when, the evolution of the

egg being disturbed by the intervention of physico-chemical agents, it was proved that the new life could come into existence without fertilization.

Thus organic life continues physico-chemical life in the natural order of things, without any of the sharp metaphysical twists and turns that are commonly propounded. From the moment when chemical or even physical fertilization suffices for the production of a living being, the question of the reproduction as well as of the production of life consonantly with the methods of energy in general is solved. What need have we of the supernatural when we have caught nature in the act? The reader can turn to the work in which, in compact form but with unvarying fidelity to scientific observation, Bohn has collected the principal results of research into the original development of sensibility and of its connection with mental phenomena. I must limit myself to the outstanding experimental discoveries and their legitimate interpretation.

I have mentioned the tropisms — geo-tropism (the attraction of roots toward the earth), photo-tropism, chemico-tropism, etc., — as such a discovery, for in them I can see nothing except forms of universal attraction. For a long time to come phenomena of that order will have to be subjected to every experimental test. When carefully considered, our motor sensibilities and reactions are found to result in the phenomenon of a mechanical displacement which for lack of anything better we characterize by the words attraction or repulsion.¹ Of them we can say nothing, as Newton himself stated, except that matters go on *as if* such powers were in action. That variously defined sensory reactions are present in the inorganic world is a fact for which the image formed on the chemically sensitized photographic plate has prepared us. Scientists do not agree as to where applied sensibility, termed consciousness, begins in the animal series. There, as elsewhere, all phenomena

¹ I again stress the fact that the stars are sensibly responsive to the action of their fellows. Thus we note definite manifestations of sensibility in bodies termed 'inorganic.'

must be connected. The transition from apparent insensibility to recognized manifestations of sensibility occurs, like all the other transitions, through evolutionary changes, certain phases of which we are beginning to understand.

From the original tropism, which indicates the first reactions of the simplest organism, we progress through the development of sensibility to the associated sensations which form the woof of intellectual life. At that point we reach the heart of the basic activities of the rudimentary mental organism which evolution will develop into human understanding. The most suggestive chapter of Bohn's work is that entitled: 'De la Finalité en psychologie animale.' In that chapter he is concerned less with setting up a doctrine of animal thought than with displaying it as experimentally struggling to accomplish the functions of alimentation, of reproduction, and of the search for better conditions of life — which are its normal functions.

The act of seeking food is not so distinctive of the animal in contrast to the plant as we have believed. Like the plants in our atmosphere, sea animals, unicellular micro-organisms, and even organisms of a higher kind find an abundance of carbon around them and can nourish themselves without seeking a living prey. Whether or not they have 'will,' the functional activities result in the renewal of the organism through alimentation.¹ Starting from the simple reflex, what sensory reactions result in the organic decisions described as the action of will? Where shall we find the dividing line between conceivable premeditation and the automatic tropisms which caused it? Tropisms and infinitely slight sensibility are the explanation given us of the activities of the unicellular organisms in a drop of water. Many persons consider them merely physico-chemical reactions of living matter. I believe that the two

¹ Is not the continuous renewal of the organism the clearest testimony of evolutionary outlay from the first activity of growth to the last? Organic renewal, though continuous, must vary in degree, since there is nothing fixed in the world — a fact the consequence of which is to be found in evolution.

explanations are almost identical. Tropisms, or elementary organic attractions with their corresponding reactions, cannot fail to depend on the physico-chemical state of the organism concerned. There, obviously, we are at the crucial point at which the inorganic and the organic meet in the course of their coördinate activities. The ingenuity of experimenters has gone far afield in the attempt to clear up as much as possible the complexity of the phenomena. What purpose does it serve to discuss the precise point at which the motor reactions of sensibility can be classified as will in the general concatenation of the human organism? I can see in the matter only verbal differentiations fit to distort the character of the phenomena, which they can express only by transposing them.

Hence I take care not to become entangled in the classic distinction between 'instinct' and 'intelligence.' What is the beginning or end of that 'automatic' activity, the manifestations of which evolution developed into the complex phenomenon of mind which man presents to us to-day? That the debate has been opened is a step in the right direction; the subject is far from being exhausted.

Mental evolution from the amoeba to the higher vertebrates offers us a field of research in which the successive forms of thought can be analyzed progressively. Our problem is the mental evolution of man from the man of Chapelle-aux-Saints, or from the Neanderthal man, to the modern man of science through slowly coördinated accumulations of knowledge. Our imperious need to know what is beyond the knowledge which we provisionally regard as assured is unlimited.

I have simply purposed to make the reader see how the eternal interrelationships of the universe, parts of which we recognize in the succession of phenomena, allow us—compel us, I should say—to go back to the far-off origins of our phenomenology for the sake of studying the facts. I have tried to avoid hasty conclusions. I hope that my statements have been sufficiently cautious not to shock those people who take alarm at the idea of surmounting the barricades of

archaic misconception behind which they have sheltered themselves.

TROPISMS, RHYTHMS

Since the subject of comparative psychology is quite new, scientific writers have assumed the task of systematizing the numerous investigations started in France and in other countries for the purpose of going back, under the auspices of Lamarck, to those rudimentary manifestations of organic sensibility from which flow the phenomena which we characterize as 'intelligence,' 'emotion,' and 'will.' To determine their relationships by means of generalizations of the established facts of our present state would be an undertaking doomed to failure, if we persist in wanting to proceed from our present cerebral phenomenology to the primal sensory activities of which it is the result. On the contrary, the task is to proceed from the original automatic reactions of sensibility (reflexes) to the psychic phenomena which they successively determine. Instead of seeking in animal intelligence something like a reducing scale of human intelligence, we should pick out from it the first forms of a psychic development, the succeeding growth of which brought about the actual state of our present mentality. We must follow the course downstream and not up.

The difficulty of the task greatly increases when we are obliged to have recourse to old words to express new conceptions. Language cannot progress except by following in the train of the mental organism, which, having determined it, cannot at first present its new formulæ except through the medium of formulæ already out of date. Of what use is it, for example, to discuss the question whether to fix the starting point of 'intelligence and will' at the appearance of a more or less definite nervous system, or at the appearance of a certain organization of neurons made manifest by the symptoms of a brain? That Lamarck himself¹ was at

¹ Lamarck had the merit of devoting his attention to following the evolution of the nervous system from ganglia communicating with one another by means of simple threads radiating to different parts of the body to the system of brain

first unable to free himself from such considerations is not surprising. His followers to-day ought to see that there can be in those words nothing to fix the origin either of intelligence or of will, for the simple reason that they merely designate transitional organic conditions in course of incessant change. For that reason, I am not going to suggest the suppression of terms consecrated by custom. They have evolved and will evolve further in their profound meaning along with the stage of life which they express. We make current use of the term soul, yet it is quite certain that we do not attach to it the same meaning that Plato attached to it.

Let the scientists who are so authoritatively opening the difficult field of investigation of comparative psychology be good enough not to trust to the neologisms so convenient for premature explanations. Their studies of rudimentary psychism, the result of innumerable experiments, are of the greatest importance, and the facts which they have observed and properly recorded have already brought to light a rich vein. But we are only at the beginning of its methodical exploration.

From experiments made by Loeb on the lower animals and on insects it appears that at the origin of the so-called organic movements we find, as was inevitable, the physico-chemical effects of cosmic energy (heat, light, electricity, gravity, etc.) appearing under three fundamental activities: tropisms, differential sensibility, associative memory. Like and spinal cord possessed by vertebrates, which presides not only over the so-called vegetative activities and over muscular movements, but also over the determination of the sensations and emotions designated by the names of thought and sentiment.

Lamarck's error was in wanting to trace a hypothetical distribution of sensations, sentiments, thoughts, and volitions, according to the stage of development, at different heights on the evolutionary ladder. Those words have the great fault of defining too rigidly the progressive stages of the nervous function. The cerebro-spinal accumulator with its plexus proceeds by too slow differentiations for us to be able always to grasp the fine thread of the evolving function in the act of change. The transition from the reflex from simple irritability to the complex influences governing volitions, the precise point at which our subjective classifications lead us to draw a dividing line by means of names in the continuous phenomenon, is of secondary interest. Science deals with cosmic interdependence as transposed in our imperfectly adapted representative signs.

the stone that falls in a straight line, the root goes in the same direction, and so also goes the worm in the sand. Geo-tropisms being a form of gravity, the tropism¹ will be every act which reveals itself as an attraction that the animal cannot resist.² So of helio-tropism, or photo-tropism,³ thermo-tropism, chemico-tropism, etc. What Loeb calls differential sensibility is, in sum, the correspondence of the reaction to the degree of action. 'The animal moves in the direction of the axis of his symmetry; that is, in a tangential line determined by the forces surrounding him. That orientation of an organism in a field of energy is what we term a tropism. . . . It has been possible to demonstrate that a great number of instincts are no more than combinations of tropisms.'⁴ We must here understand the word 'instinct' as meaning the earliest manifestations of sub-psychism.

To assign to the tropism a place in organic activity, all we need do is appeal to the reflex,⁵ as Loeb has not failed to do. 'A reflex,' he writes, 'is a reaction caused by external excitation and resulting in coördinate movement, as, for example, the shutting of the eyelid when a foreign substance touches the conjunctiva, or the contraction of the pupil under the action of light.'

The transmission of variations in the tips of the sensorial nerves to the nervous center, so that they may reach the motor nerves and finally pass to the muscular fibers the contraction of which they control, is what we denominate reflex action. In such action Loeb sees merely a phenomenon of helio-tropism analogous to those observed in

¹ J. Loeb: *The Dynamics of Vital Phenomena*.

² Above all, let no one take the word tropism (which refers simply to the act of turning) in any sense that implies an entity and regard it as an explanation. It is nothing more nor less than the name of a scientifically observed movement in which the 'will' counts for nothing.

³ Photo-tropism is positive or negative according as the animal is attracted or repelled by light. Thus, in the case of plants, the geo-tropism is positive in the root, and negative in the stem.

⁴ J. Loeb: *The Dynamics of Vital Phenomena*.

⁵ Indeed, we can say that the tropism is a physico-chemical reflex.

the plants, which have neither nerves nor nerve ganglia, and the presence of which in animals merely assures a greater speed of conduction. It is the amount of complexity in the reflexes that through coördinated reactions responding to exterior excitation constitutes every degree of hereditary instinct. 'It is obvious,' writes Loeb, 'that there is no clear line of demarcation between reflexes and instincts.'¹

Indeed, it appears that, as automatic movements through which vegetables and animals satisfy their fundamental needs, reflexes and instincts fall within the limits of the tropism. The tropism thus appears to be an irreducible automatism, physico-chemical in origin and acting within the limits of so-called organic activity. Through differential sensibility, the alimentary organ intervenes in order to react, according as its means permit, to the composite activities in order to bring them into association. 'Consciousness is nothing but a word serving to designate phenomena determined by the associative memory.' 'By associative memory,' further declares the author, 'I designate the mechanism by means of which an excitation brings about not only the effects that result from the nature and specific structure of the irritable organ, but also those other excitations which formerly acted on the organism. When an animal can be educated or trained, he possesses associative memory.' After all, it is only a question of the more or less prolonged echoing in the organ of the impression naturally associated with similar impressions. Thus are connected the general manifestations of the Cosmos and the differentiated manifestations of our psychic organism, which we cannot classify unless we go back to their starting-point.

Such should be the constituent dynamics of the phenomena of a sensitized organism, the psychism of which is but a manifestation of synthesis. There exists, it seems, a happy precision in the organic activities which formerly had not been suspected. For that very reason tropisms have been exceedingly popular in the scientific world. Through them we obtain new evidence of the successive coördinations of

¹ J. Loeb: *The Mechanistic Conception of Life*.

all the cosmic activities which our classifications subjectively separate. And this evidence confirms the fact that psychology can be no more than a department of biology dependent on physico-chemistry.

'Whether positive (attraction) or negative (repulsion), photo-tropism seems to be a purely physical and decisive reaction, that is, inborn, automatic, and independent of all choice and consequently of the psychic phenomenon. . . . If it is conceded that photo-tropism is characterized by an asymmetrical motor action when the body is unevenly struck by the light rays, it seems probable that more or less intense chemical reactions have acted as its agents. Indeed, light radiation ranks among the most powerful chemical agents. . . . It acts with the greatest energy on living substance, and especially in the case of plants it plays a nutritive rôle of major importance, for it decomposes carbonic acid through the intermediary of a green photo-chemical substance named chlorophyl. Thus photo-tropism originates in chemical modifications provoked by light.' ¹ Loeb and Bohn have demonstrated experimentally that we can very easily ascribe definite photo-tropism to molluscs, to the crustacea, and to the algæ. Finally, Loeb shows us variations of the signs of photo-tropism (positive and negative) under the action of nutritive or reproductive phenomena.

'The organisms automatically respond to the stimulus of light by determinate orientation and movements. Whether or not provided with visual organs, they react as if they had them, and their reaction is not the result of a phenomenon of vision, but a response by photo-tropism of the living substance which constitutes them to the energy of the light rays.' ² I have already said that all forms of cosmic energy exercise a physico-chemical action on the organism, and on its plasma which may take the form of thermo-tropism, hydro-tropism, chemico-tropism, geo-tropism, stereo-tropism, rheo-tropism, or of anemo-tropism,³ etc. All the motor reactions of tropism take place and end with gen-

¹ Bouvier: *La Vie psychique des insectes*.

² Loeb: *The Mechanistic Conception of Life*.

³ Consult Bouvier.

eral activities of the different or differentiated sensibilities, which characterizes the organ at every stage up to the stage of clearly defined sensations. The distinction between automatic tropism and sensation is not always easy to establish. This is not surprising since objectively both are the result of the same evolutionary coördination in our subjective stages.

The physico-chemical explanation of tropisms defines them as the automatic response of the organ to exterior stimuli up to the point at which differentiation decreases the apparent share of this automatism and increases the individuation of sensibility. The organic rhythms, in harmony with the cosmic rhythms, duly affect the tropisms through modifications of the symptoms (positive or negative) according to the periodic oscillations of physico-chemical states, under the influence of heat, light, electricity, etc., as those forces may be distributed. The proportional water-content,¹ which varies with the tide, determines in the case of marine organisms the oscillations of the physico-chemical states which rhythmically influence the tropisms. Rhythms of circulation, of digestion, of cerebation (sleep and waking), of pathology (paludism), æstivation, and hibernation thus mark the oscillation of tropisms—an oscillation which may reach even the periodicities of egg-laying and the cacklings that follow it.² Variation in water content has even been advanced as an explanation of artificial parthenogenesis.

The phenomenon of fatigue seems to be the result simply of the rhythmic distribution of energy by *quanta*. Life and death are merely the rhythms of cosmic activity, that is, oscillations of energy. I need not follow farther the authors of the young school in their interpretation of numberless experiments which time will coördinate.

In the sense in which the word is commonly understood,

¹ Ninety-eight per cent in the transparent animals that float.

² The rhythmic dances of Siva at the three periods of the daily transit of the sun (Temple of Tanjore and the Madras Museum) indicate that our remote ancestors had noticed this sequence of the universal progression.

there is no intelligence, properly so called, in the amoeba any more than there is in the crystal. In those two organisms we find, nevertheless, sensory reactions which we can call 'will,' for they are characteristic of a stage of individuation reacting in determinate activities. The fact is that motor reaction, which at present our verbal forms term tropism, occurs before differential sensibility, and before the phenomena of association which by various organic phases allow us to classify the constituent and related elements of thought. Furthermore, it is the reactions of differentiated sensibilities and of associated phenomena that produce reflex activities, or, if you prefer, create midway between tropisms and will what appears to be individual independence.

On all these matters, and also on the development of the nervous system, Lamarck expounded views which prove his genius, and which have been confirmed by modern observation. To them we can only add that elementary tropisms may be no more or less than shifting aspects of universal gravity. I have repeatedly said that Newton himself did not suggest that the word attraction solved the riddle of the Cosmos, but limited himself to saying that things acted 'as if there were attraction.' Tropisms, named according to the energies which cause them, are no more than a stage in the elemental activities of cosmic evolution, which has neither beginning nor end. Atomic explosion is an outstanding example of tropism. Under the incessantly evident dominion of tropisms, we are the transitory products of the eternal change which in our folly we insist on trying to arrest.

How tropisms act **can** only be discovered by an immensely long inquiry based on experiments on living subjects. As yet only a beginning has been made. The mistakes we make to-day are more likely to be the result of hasty inference than of real ignorance. Lamarck began work at the right places. To a remarkable extent, the work of the present generation has emphasized the value of his wonderful preliminary work.

Glance at some of the publications on the subject, and you will wonder at the amount of patient ingenuity required in the tortuous course of the most thankless labor in order to reach the first rays of light.¹ From every direction we shall continue to attack that problem of problems, 'matter-energy,' in order to ascend from the first mineral individuations — the result of the evolution of physico-chemical complexes — to the progressive individuation of organic sensibilities the functioning of which produces animate life in all its stages. What a poor figure the indefinable absolute of the metaphysician cuts before the incomparable wonders of this attitude of cautious relativity!

FROM TROPISM TO ORGANIC COMPLEXITY

Thus we find ourselves progressing from physico-chemical tropisms to the state in which action is determined by the differential sensibilities which, because they are associative phenomena, organically connect present with past sensation. As we pass from radiates to articulates, those unions lead to the differentiations of a ganglionic nervous system which in course of evolution changes into the ultimate coördination of plexus, spinal cord and brain. Do we not see the skin, sensitive to light, become individualized in pigmented spots which through evolution become by successive stages the organ of sight?

The radiates, which have preserved the geometrical lines of crystals, exhibit merely separate ganglia communicating with one another by thread-like nerves. They represent the first achievement of sensory individuation by means of motor reactions in which the elementary reflex becomes distinct.

The molluscs have ganglionic masses, but no spinal cord. The most important ganglion cannot aspire to the title of elementary brain, without folds, until the nerves of the sensory organs happen to terminate in it.

The articulates, in which the rigidity of the radiates

¹ Consult *La Parthenogenese naturelle et experimentale*, by Delage and Goldsmith.

begins to take on some of the suppleness of fully evolved organs, have a knotty longitudinal cord with thread-like nerves ending in nodosities. We may consider the anterior ganglion as a first outline of a brain, since the individualized functions of sight and hearing are connected with it. The plicate hemispheres appear later.

The vertebrates offer us a synthesis of differentiations — spinal cord, nerves, plexus and brain with plicate hemispheres,¹ leading by associated sensation to the phenomena of the ordered sensibility described as psychism — incomprehensible to any one who has not traced its genealogy.

I borrow from Lamarck this sketchy outline of the facts which will allow the reader to find his way amid the uncertainties of a dawning light.² No further evidence is needed to show that the biological phenomena and the psychological phenomena which are implicit in them are one in the group of organic activities which we have subjectively classified. We might have suspected it from the immemorial failure of the most eminent psychologists, who attacked the problem from the wrong end.

The irritability of the elementary organism appears so nearly simultaneously with physico-chemical reaction that it is sometimes very difficult to distinguish between them. But when that irritability rises to the point at which it may be termed sensibility, the coördinated sensations react as the phenomena of a definite psychism. On that basis, Bohn divides the animal world into three distinct series. The first group consists of the infusoria, the polyyps, the

¹ Lamarck considers the brain as an accumulator of the energies of the environment. It seems to me that as much might be said for all the organs. The resumptive concentrations of the cerebro-spinal organism assure it a coördinating power that determines the course of action.

² From the point of view of the action of environment, Lamarck suggests the following classification:

- I. Animals without any nervous system; for example, the infusoria.
- II. Animals, the nervous system of which, lacking ganglia, can control nothing except muscular contractions, such as the echinoderms.
- III. Animals to which a ganglionic nervous system permits having impulses and feeling, such as articulates and the mollusks.
- IV. The vertebrates, which comply with the foregoing conditions and have intelligence.

starfishes, the worms, etc., the reactions of which are akin to those of the members of the vegetable kingdom. They show a pronounced irritability to light, to gravitation, to humidity and to aëration. Later, a more precisely defined sensibility gives the sensations a special character, as is obvious in the case of the articulates and the vertebrates which form the second and the third groups, which their differentiation little by little frees from the environment in which they had their origin. The crustacean and the insect have their organs isolated from surrounding matter by the chitin of their shells, a trace of which we find in the ganoid fishes, which are vertebrates. In the case of the vertebrates, the sustaining organs (cartilages and the bones of the skeleton) leave the viscera exposed, keeping rigid protections to guard the nervous system,¹ which is progressively differentiated. The dominating brain followed after the ganglia. Individuation is perfected by making the organ independent of its environment.

If it is generally admitted that there can be no question of a single animal stock, at first thought of as a means of simplifying the proposition, it is no less necessary to connect all the branches to a common trunk of rudimentary organism representing the original manifestation of an evolution from the physico-chemical to the biological order. Loeb maintains that animals are chemical machines, and he always brings superabundant proofs to support his dictum.² No matter what terms we employ, the organic mechanism — the evolutionary product of the mechanism described as inorganic — leads, by means of its tropisms (principally heliotropism) of differential sensibility and of associative memory to a general coördination from which no part can be excluded.

Any one who without preconceived ideas takes up the subject of the inseparability of phenomena will quickly see that there is no dividing line between instinct and intelli-

¹ The viscera are sufficiently protected by the attitude of quadrupeds. The erect posture exposes them to shocks.

² J. Loeb: *The Mechanistic Conception of Life*, and *Chemical Fertilisation*.

gence. The two words, like so many others, were spontaneously invented to distinguish by contrasting names analogous phenomena which differ only in degree. Between instinct and intelligence there can be no difference except in the stage of organic evolution which they have respectively attained. The word psychism seems to me adequately to describe this evolution.

To cite only one example, the well-known homing instinct among bees and ants is the natural result of an associative memory for landmarks, the stages of which we cannot define, and which is due to an acuity of sensibility lacking in our organism. The same is true of the flight and return of migratory birds. The process is none the less identical with our own, but with a difference of means. I have already said that bees, if carried beyond the ordinary radius of their flight, can find their way back to the hive. But if the hive is slightly displaced, they do not find it. Their associations are inadequately coördinated. Similar is the case of the carrier pigeon that, recently installed in a new home, returning after an absence of two days to the new dovecote where his mate brooded her eggs, turned about in every direction, but was unable to find the door by which he had departed. I saw him fly about for a full hour, not two feet from the entrance, without being able to recognize it, because it was on a different level.

Much has been said about the 'mathematical' precision of the needle-strokes with which the *Sphex* and the *Pompilus* paralyze the *Hymenoptera*. Fabre goes into ecstasies over it. To-day it is known that those needle-strokes are continued until chance brings the desired effect.¹ Fabre tells of a wasp in Languedoc which hunts grasshoppers of the genus *Ephippigera* for its young, paralyzes them by piercing them under the thorax, and buries them after having laid its eggs on the flank of its victim. When Fabre interrupted the process of burial in order to test the Lamarckian habit of the animal, he could not at first change

¹ On the social life of ants and other insects, a topic on which imagination has given itself free rein, read Bouvier, Bohn, and Fabre.

its routine. However, he noted cases of 'adaptation to circumstances.' The same holds true of the sacred scarab, rolling the ball of dung which is to nourish it in its subterranean home. The same is also true of certain of the Sphegidæ, hunters of spiders, which, with more or less difficulty, carry their prey in spite of obstacles to a particular destination.

The procedure seems to be automatic, and for that reason observers have maintained that it was merely the effect of tropisms, connected by the imprecise workings of an associative memory. This is the very middle of the delicate transition by successive steps from unconsciousness to consciousness, where our best methods of observation succeed in establishing only dubious landmarks. Bouvier, after citing numerous experiments on different insects, concludes that certain of them 'can deal with unexpected contingencies.' 'They do not act like automatons, and the memory which guides them in these circumstances seems in its essential characteristics to belong to the same degree of psychism as does human memory.' We are accordingly brought to the question of apprenticeship, that is, of education. Formal experiments show that certain insects are capable of learning. This new linking together of Lamarckian habits marks a long step in evolution. The same is true of the crustaceans.

Bouvier notes, moreover, that the power of mnemotechnic association varies greatly, not only among species, but among individuals of the same species. With equal accuracy he observes that 'certain sensations impress themselves rapidly on the nervous centers and cause motor reactions that quickly assume an automatic character. . . . And if such is the result obtained through a short experimental apprenticeship, we have the right to think that the apprenticeship of nature leads even more surely to automatic habits, for it is the action of environmental conditions which continuously influences the individual and his descendants.' That observation is of capital importance to the mechanism of evolution and to the aid afforded it by

education. Among the higher species we can generally watch this apprenticeship. On the highways we have seen horses become more and more accustomed to automobiles. Hens, however, continue to run under the wheels, and cows, without even paying us the compliment of a reflex, persist in barring the way. Dogs, formerly aggressive, have become nearly indifferent.

Starting with the physico-chemical automatism of tropisms, our conscious actions remain on the verge of a relapse into their original state, the echo of which can still be heard in the shortened reactions in animals supplied with a nervous system. This oscillation, or, to speak correctly, this rhythm, playing between unconscious tropism and the energy of a more or less defined consciousness, and *vice versa*, explains in the most natural way the atavistic forces which so greatly retard our efforts at disinterested observation. There we reach the profundities in the make-up of our activities. The spontaneous modifications of habit reveal evolutionary action, as contrasted with the retardation caused by automatic tropism, which is one of the fundamental laws of the Cosmos. Through accessions of energy, the width of the oscillation increases physico-chemical automatism, regulating the progressive individuation of the ensuing developments. We can, then, disregard the scientists who are still floundering in Descartes' theory that animals are machines.¹ The spontaneous modification of habit in the case of insects is clearly established. That is the important point.

The fact makes it unnecessary for me to take up after Bouvier what he calls the evolution of instinct, for to establish evolution I need not pause for any metaphysical consideration of the word instinct, which has no objective

¹ Uexhull: 'For the biologist, animal psychology cannot exist. Bethe grants certain psychical aptitudes to the vertebrates, but oddly enough denies them to the invertebrates, whereas Lubbock puts ants in the same rank with men in terms of intelligence.' To which Bouvier replies 'that an animal proves its psychical aptitude when it is capable of learning and of modifying its conduct,' which does not prevent associative memory from restoring the insect to its original automatism.

definition, but with which the distinguished scientist does not dare dispense. As I have already pointed out, the phenomena grouped under the name of instinct are compounds of automatic tropisms and of sensory reflexes which progressively reach different degrees of consciousness, the definiteness of which increases with their evolution. The hereditary nature of habit is established beyond any possible doubt. It is what is termed the inheritance of acquired characteristics.

In spite of marked progress, the phenomena of heredity are inadequately explained. Procreation through segmentation, which is at the origin of reproduction, easily explains general heredity, which is nothing but the evolutionary progress of organic development. That the dioecious organism succeeds the monœcious cannot change the primary conditions of the phenomenon of heredity. The mere difference between the presence of the organs of sex on the same plant and their separation on different plants is after all of secondary importance, since all parental qualities are fused in the egg. The problem of the apportionment of parallel or crossed inheritance is singularly difficult in view of our means of observation. We can establish from the evidence the transmission of biological activities in which the more or less distant waves of an atavistic morphology can be heard to resound, but the compounds of every sort that go to make up the character of the individual are still beyond our reach. The unknown principle lies perhaps in the reproductive moment, which is infinitely variable, and in which are condensed transient combinations of fleeting waves which produce such and such a strengthening of certain qualities, or such and such a toning down of others.

What seems to be established is that the evolutionary acquisitions gained through apprenticeship are inherited. Fabre has cited numerous cases of insects reacting automatically to the snares set by the experimenter, with no concern about the result for which they were working, such as the building of a nest, the disposition of food for the

coming larvæ, etc. That is what the eminent naturalist of Serignan calls 'aberrations of instinct.' What advantage is there in attributing to the creature a definite instinct, merely to see it fail at the first step? How much simpler it is to rely on tropisms (scientifically observed), evolving in the direction of the more or less confused primary reactions of an undefined or differentiated sensibility. When these automatons are capable of learning and of bequeathing their knowledge to their descendants, elements of evolutionary psychism cannot be denied them.

In a chapter on habits, entitled 'Psychologie comparative,' Bouvier speaks of the *Pompilus* stabbing and paralyzing the spider, in order to attach to its flank the egg that is to supply the food of the larvæ. 'How has this procedure evolved? The original maneuver must have been much like that which Fertou observed in the case of a *Pompilus* related to *Salix opacus*,¹ in which the stabs were administered haphazard in every part of the body from the mouth to the end of the abdomen.' We need not be astonished if time and selection have brought certain species to the superior skill of the *Calicurgus scurra*. Between the two extremes, the other Pompilidæ show all the intermediate stages. It even happens that certain species simply attach an egg to the body of a spider, which is finally devoured by the hostile larva.

There is, according to the species, the same variety in the disposition of the nest as there is in parasitism. Bouvier concludes that these innumerable forms of organic activity are evolutionary stages representing psychic specialization made precise through the action of apprenticeship and heredity.

When the bird builds its nest, when the hen scratches away the lime from the wall to build up the shell of her eggs, and when she turns the eggs of her hatch in order to obtain an even distribution of heat, the bird does not set up an argument in our forms, since she lacks the requisites. Tropisms, differential sensibility, associative memory, to-

¹ There are nearly a thousand species of Pompilidæ. Fifty have been studied.

gether with the help of apprenticeship and heredity, lead her to the same results.

Of the comparative psychism of vertebrates, we have since the remotest ages grasped only the elementary aspects. To record scientific observations in order to coördinate them as they pass is an enterprise which has generally been undertaken in the wrong way, since we persisted in seeking human intelligence in animals instead of following the course of psychic progression through the living series up to man. In spite of every obstacle, right up to the developments of human intelligence, experimental science has led us to such achievements that our hope of the progress of relative knowledge is unlimited.

IV

GROUP EVOLUTION

In the eyes of science individual man is not the whole man. The course of his evolution, which defines and determines him, is complicated by the fact that he lives gregariously — a fact which forces a shaping and an evolution of human life¹ in which all the complexities act and react on one another.

At whatever degree of animate life we may find the animal, it is never in the strict sense of the word isolated, for it begets beings which, at least for a time, become the companions of its life. Even when temporary the family is a group of mutually dependent beings; it is the 'cell' of an organism of increasing complexity, the principle of which is the interdependence of the constituent parts and the en-

¹ Jean Perrin, who delights in figures, offers us the secure enjoyment of the sun for no more than thirty-three billions of years. That is our descendants' business. All I wonder about is: to what point will the course of man's present evolution carry him? The universe will be different, and so will man be. Let us suppose him endowed with a skull of such monstrous size that it seems ready to burst. What will he do with the great development of his knowledge? What a complication would result if he were to become too learned! To reëstablish the equilibrium I can see no means except our old provision of misconception. He can be wrong as much as he pleases up to the very day when a collision with some wandering star disposes of any excess of intellect.

vironment. The natural history of social groups may some day be established. Meanwhile I cannot avoid comparing the evolution of the individual and the evolution of the group in the hope that in the process we may acquire some light on the development of social man.

The individual sacrifices something of his Ego in exchange for a compensating social advantage that results in personal growth. There is a biological interdependence among the organs and in the general organism even in the case of the antagonistic parts which have a function in our moments of 'harmony.'

The harmony of organs evident in every organism is cited by metaphysicians as a decisive argument in favor of the entity, the vital principle, which is the animating source of that synthetic coöperation the coherence of which constitutes life. Comparative biology replies that, like physico-chemical forms, every kind of organic form is possible for a time, provided it can defend and reproduce itself — a feat which necessarily requires an automatic harmony of function.¹ Granting the sketchy beginning of a formation, every form which fails to attain such durable harmony appears only to disappear immediately. In that case, why should the harmony of the cell or of the organ be any more remarkable than the harmony of the crystal, which is not credited with having a vital principle?

Cross-breeding can multiply species indefinitely. 'The number of species that exist to-day is but an infinitely small fraction of those which can and might develop, but of which we are ignorant because they neither live nor reproduce themselves. Only that number of species can exist whose automatic mechanisms of preservation, of conservation, and of reproduction are not too inharmonious. Discordant or defective specimens are the rule in nature. Harmoniously coordinated organisms are rare exceptions. But because such organisms are the only ones that we see, we get the false impression that so far as animal nature is concerned, the adaptation of parts to the general plan is a general and

¹ Roux.

specific characteristic distinguishing it from inanimate nature.'¹

Doubtless, evolution has already performed, and will continue to perform, its task of adaptation, that is, of attenuating the original lack of harmony. This is a powerful factor in modifying our underlying savagery. Hence we see that in terms of evolutionary rhythms, the 'morality' and the 'civilization' of which we are so proud are chiefly successive reconciliations between an egotism which springs from our inherited instinct for self-preservation and the evolutionary altruistic impulses which have always characterized our species. Nothing better explains the contrasting evil and virtue, barbarity and mildness which govern our individual and social activities. An example of this is the old baboon who, although safe on his cliff, threw himself among the dogs to rescue his friend. Man often continues to practice brutalities inherited from the beast, whereas devotion to his little ones or to his chosen comrade sometimes makes the beast take desperate chances.²

Since the law of least action is only a mild way of stating the universal law of might, everything naturally tends toward a supreme and unlimited autocracy. It is noteworthy that in modern Rome the luxurious representative of the crucified Christ still claims a similar authority.

Thus it was brutal excesses which brought about that human charity on which we now base the high-sounding formulæ of our social relations. Associated organisms, whether capable or incapable of speech, first reacted to one another in two important institutions: slavery and anthropophagy.³ Those two activities of primitive humanity mark the starting-point of an altruistic evolution from savagery to civilization. If our history had begun in Eden, in semi-perfection, this statement would be nonsensical. Evo-

¹ J. Loeb: *The Mechanistic Conception of Life*.

² The classic example is the devotion of a dog to his master.

³ Very recently great liberators like Washington and Jefferson owned slaves. So did both Greece and Rome, founders of the highest civilizations, as well as many other races.

lution contemplates man in process of continuous growth; Biblical tradition represents him as moribund at birth. We have become exhausted singing the 'poetical harmonies' of the world, for they have suggested only reiterations of wonder which are in no way enlightening.

The necessarily ignorant masses had rather marvel than understand. They respond quickly to strong emotions, whereby they hope to avoid the effort of thinking. The masses are instinctively atavistic, that is, conservative, even when they consider themselves revolutionary. In-genuously they expect an idyl of social peace to spring from sudden outbreaks of brutality.

You may ask whether the State was originally religious or civil. How can we classify the spontaneous emotions of the first human groups, about whom we know nothing? In those days the 'religious' and the 'lay' element could not have been distinguishable, since analysis did not exist. It was a different matter in the Roman Empire when the Christian religion was a *de facto* association, interdicted or tolerated as the case might be. By way of compensation, when circumstances favored, it took the whole power of the state into its own hands and based on its action the dogma of its supremacy over the civil power with which it is still quarreling. It does not pretend to be the perfect social state, the coming of which it prudently postpones to another life. Its chief aim is to rule us. Has it not launched its thunderbolts even against crowned heads? It has burned at the stake only those who could not defend themselves. As an ideal of social life, it proposes the isolation of the monastery (an importation from Asia), as supremely efficacious for the eternal salvation of man. In recommending celibacy as superior to marriage,¹ in denouncing the world in order to exalt the convent, historic Christianity has taken a position opposed to society itself. But nature has spoken louder than dogma.

The reason why Christianity took hold of the masses at

¹ Every one knows the dictum of Saint Paul: 'Man does well to renounce marriage.' Epistle to the Corinthians.

the preaching of the Apostles was that Hellenism had left them nothing to which to cling. Saint Paul's sermons to the Gentiles were only a rehash of old Asiatic themes based on the oldest emotions of the Aryan race. In vain did Julian, emperor and philosopher, try to save outworn myths. In spite of the adjurations of Libanius and of so many others, and in spite of the horrors of the arena, the faith of the masses was not shaken. New words for old emotions! Such in essence was the Christian revolution amid the radical tumults of the time. The revolutionaries of '93, acting in the name of the Goddess of Reason, knew only the *ultima ratio* of violence, of which the example had been set them by the Church. They laid sacrilegious hands on the men of science who were to establish true freedom. The formulæ of ideology, master of a popular metaphysics, were inscribed on walls. The result was romantically sonorous sounds vibrating in minds that did not know what they wanted. Quickly disappointed hopes thrust them into the lowest depths.

Since individual evolution is in itself a phenomenon of limitless complexity, to which are superadded the inadequacies of education, what can be said of social evolution, which contains the incomprehensible components of every sort of individual evolution complicated with the harmonies or discords aroused by the emotion of the moment? To extract from this confusion an even ordinarily intelligent opinion is a tremendous task. Discounting interested motives, each of us clings all the more tenaciously to his premature inferences which in view of past discomfitures he feels more and more surely to be unsound. We at least have the satisfaction of having expressed an ideal in words, and we worship it as our life's achievement.

Change of pain is almost as good as relief — as Saint Laurence realized when he turned on his gridiron. New words give the illusion of impending improvement. In spite of intervals of bad humor, a vague calculation of probabilities helps us patiently to await a future of which luckily we know nothing. Who, indeed, never expected

help? If beneficiaries are lacking, the benefactor is there to remember his benefaction and in moments of frankness even to talk about it.

In our secret souls, our private interest and the public interest (theoretically identical) often conflict to a dangerous degree. That is the fundamental characteristic of the history of humanity. The social order too often results only in prolonging conflict through procrastination, while man himself, his life, his thought, his actions, his hopes, his ambitions, his regrets, and even his remorse, if he is fine enough to feel that emotion — all the perturbations of his soul — are brought into adjustment with the activities of the individual and of society through an incessantly renewed debit and credit account.

A mere statement of the problem is enough to discourage any one, so inextricable is the confusion of its infinite complexity. But what concerns us here is not a theoretical exposition of an anticipated absolute of which in the last analysis we should have to despair. Like the life of the individual, the life of the group at first requires empirical solutions and must run the risk of the consequences. Is it surprising that such an arrangement is not equally satisfactory to every one?

Life independent of society is inconceivable; this is as true of savages as of advanced civilizations. The life of the individual and the life of society must be organized, adapted, made to run smooth. The convent is only a fiction; it is a form of generally accepted social contract for the purpose of sharing what people are pleased to call idealism. But man must live, and from the very beginning it has always been a question how to divide the bison that the hunters have brought in. Summon, therefore, a council of the wise men that they may deliberate on good rules, inspired by auguries, which will give general satisfaction!

Without calling councils, the unconscious Cosmos solves all problems by following the law of least resistance.¹ Such

¹ The truly creative Word of Saint John, of the Atman, and of the Brahman of India, is, and always will be, the supreme rule of that resultant of constantly shifting forces.

was the original law of the primitive human groups, which were analogous to animal groups. It was the law of controlling and controlled forces modifying each other to produce the decreed rhythm. The selfsame law and the selfsame methods determine the grouping of men and of animals. Thus the governing and the governed are moulded by their experiences and by their emotions, which alternately produce authority in some and obedience in others. As to leadership, the birds, who have so remarkably solved the problem, have not told us their secret. Be that as it may, in the case of a civilization in process of development, rulers and ruled have been the products of energy or of sloth disguised under seductive names. There, as throughout all human history, the development of words has outstripped that of realities. One must admit that the masses have in various and sometimes contradictory ways appeared, and still appear, to be satisfied with this indifferently poor makeshift. Generally speaking, terrestrial authority is modeled on celestial empiricism and depends on the decisions of irresponsible wills made alluring by remote hopes. Even to-day the terms of those promises are still familiar. I point out the fact; it needs no proof.

Less fortunate, but wiser than man, the animals utter no complaints and express no desires beyond the scope of their abilities. Exclamations of wonder at the existence of systematic social organization among the animals have become hackneyed. Bees and ants are current literary topics. Even prominent scientists wonder at the sure workings of a social life the government of which depends on reflex actions, since brain, which acts as a reservoir of sensations, is wholly lacking. The reverse of this condition is remarkably evident in the social life of mammals and of birds. Birds particularly excel in the organization of vast flocks, whether for the temporary purpose of migration, or for other, and to us unknown, reasons. I have already spoken of the immense flocks of small birds which I have seen in the Sudan manœuvring with incredible precision. We do not know the reason for such assemblages, which

must make the problem of food more difficult. The prodigious clouds of locusts which devour the harvests are matters of common knowledge. An inferior psychic organization cannot produce a superior social state. These examples seem to represent the completion of a particular phase of evolution in a very limited field.

The migration of birds is one of the phenomena of which we talk most and know least.¹ The birds generally start at night and always against the wind. Regardless of fatigue, they continue to fly until they reach their destination. Naturally stragglers fall behind, and these are sometimes picked up by ships. They have methods of holding to their course which baffle us. Migrating birds are obviously endowed with a highly perfected 'sense of direction.' Scents from far distant lands (which in part explain why migrants always start against the wind) as well as the first chill of autumn doubtless influence the birds to start. I saw a young wood pigeon, hatched in Paris, so moved by the desire of the unknown that it killed itself against the bars of its cage.

Along the pine-covered seacoasts the start and return of migrations occur with almost perfect regularity. Swallows are not the first to leave, but they seem to be among the first to feel the cooling of the atmosphere and, however the decision may be reached and the signal given, groups of families gather for a common purpose. It has seemed to me that in the course of the autumn I have noticed that they had methods of communication.

Definite groups gather at definite points. In obedience to what rules? Small preliminary flocks form locally. There must be a common understanding and a supreme authority to select gathering places and to determine the direction to be taken. I have often watched these preliminary consultations. They vary in length. Sometimes a few hours are enough to make all the arrangements. Again, I have seen the discussions last for a long time. The birds gather on

¹ The concerted action of migration indicates a clearly defined stage of mental evolution.

telegraph wires or on roofs. Then, uttering little cries, they fly about excitedly. In those flights occurs the linking together of definite impulses precisely as in the case of our gestures and talk, for they correspond to agreements reached through the use of vocal symbols. When the birds are at rest, one can distinctly hear their notes uttered in a minor key, but loud enough to be heard from near by. Secondary groups join the main flock and quickly disappear. Their whole world is in commotion.

For some reason which I do not know, the flocks that live in the north do not start until after the rest. Whether because they are weary, or because they feel obliged to perfect all their arrangements for the long journey, they will assemble some fine morning a few meters from the sea on the wires of my fence, perching with heads bent toward the ground and wing to wing as if for a final deliberation. From time to time one of the female migrants abruptly rises to perch at a different place in the assembly, where, perhaps, she issues some order. From my post, I can follow the activities of the flock. Sometimes there ensues a great quiet — perhaps for rest. Then follows a chirping discussion, broken with a crisscross of interruptions. I deny myself the malicious pleasure of making certain comparisons, not advantageous to us of the human race. The swallows fly about, scatter, cleave the air with infinite zest, hunt around, provide themselves, perhaps like ourselves with useless 'necessaries.' With the earliest dawn the winged caravan is already far away.

If I have delayed over these common feats of animal intelligence, due no doubt to the fact that birds have a wide range of signs which permit them to form complex mental associations, I have done so less to show to what perfection the concerted manifestations of animals can attain than to emphasize the operation of a series of concatenations developed from the primitive forms of living organisms down to the development of superior coördinations, by no means perfect. Compare these highly intelligent activities with the gross stupidity that allows a bird to hatch the egg

of the cuckoo along with its own, only to feed the intruder at the expense of its own brood, which the interloper will soon succeed in thrusting over the edge of the nest. Birds seem to have more or less temporary mental associations, apparently intended to accomplish some definite purpose.¹ These are a few of the evidences of group evolution among animals which are most easily observed.

I have described the flight in V formation and the change of leader that occurs on the way — which is certainly not a matter of chance. That is certainly a product of a group evolution which results from the harmonious evolution of individuals. Descartes or Lamarck — we must choose between them. The crushing defeat of a reactionary Cartesianism is inevitable. People used to try to dodge the problem by falling back on the word 'instinct.' In the absence of any positive knowledge a word was a great help. As for the misconceptions of the 'known,' and the misinterpretations of the 'unknown,' metaphysics made them its special business. Instinct became a sort of sub-intelligence, as mysterious as the 'soul' itself and no less capable than the 'vital principle' of deflecting us from the path of scientific knowledge. I have already said that so long as we were content to compare them with our own mental life, without seeking their source in the organic interconnection of the recognized lines of evolution, the mere recognition of intellectual accomplishments in the course of the animal series could be nothing but a subject of sterile wonder. Our concern is less to be amazed at disconnected exhibitions of animal understanding than to seek first of all the biological interconnection of the animal series in the evolution of its sensibility.

That, unmistakably, is the point from which comparative psychology, originating in the primitive irritability which determines action, and which is closely akin to physico-chemical reaction, starts on its way toward the first com-

¹ If one argues from the astonishing aptitudes which birds display in a particular case that they will manifest the same faculties in new circumstances, as does man, one is doomed to disappointment.

plexities of association as the organic activities of the living series progressively discloses them. We are specimens of humanity, and for us to know is to define relationships and to classify them in series of the coördinated waves from which spring the resonances which make understanding possible. Can animal intelligence, then, differ in its manifestations from the sum total of variously enlightened consciousness? The difficulty of mental association, caused by the inadequacy of symbols, makes the activity of the mental phenomenon more precarious in the successive subconsciousnesses in which failure of coördination is continually manifest.

We do not appreciate the vast labor which will be necessary to disentangle the first sensibility of vegetable life from the actions and reactions of inorganic evolution, or the slow processes of animal evolution required to lift us to those complexities of association which determine the phenomenon of conscious thought. After that is accomplished comes the undefined task of classifying particular group complexities.

As a matter of fact, we find stages of group evolution which differ in their characteristics. Wolves gather for attack as well as for defense. So do the members of the deer family. From the boat that ascends the White Nile you can see, silhouetted against the sky, herds of antelopes which cannot be counted. To what extent, and for how long, do they stay together? The pleasure of propinquity seems to be the motive which impels horses to congregate in the Argentine pampas, which contain no enemies. You should see them racing along, neighing with pleasure, on either side of the automobile. As between assemblies emotional in character and utilitarian ones there must necessarily be different degrees of organization. I have said that when grazing domestic cattle so place themselves that no one can appear at any point of the horizon without being observed by some sentinel.

A long hierarchy of organic groups which, beginning with aggregations of molecules, continues through all the activ-

ities of biology and ends in the highest achievements of human society — such is the general phenomenon which, in view of the evidence, no observing mind can longer question. In the field of animal life each one of these groups calls for separate study, and a comparison of the results will be of the most vital interest because of the light it will shed on the history of the formation of human groups into families, tribes, cities and nations, balanced in different degrees between the need of union and the primitive disposition to contest. Such are the deep-sunk roots of this universal history, presumptuously taught by our preachers, who solemnly trace the origin of all social life from the burning bush on Horeb.

To-day ideological anticipations sometimes cause danger of misconception. Changeable man, guided only by words arbitrarily treated as realities, eagerly scales the dizzying heights of metaphysical dreaming without taking any account of the hereditary limitations of his race. If we are to trace the family and the tribes and all the other evolutionary groups from primitive ages to those modern achievements which require strict rules of organization, we must go back to the individual. There must be a chief, and the first is the Pater Familias, exercising the right of life and death over his children. In tribal groups there was an assembly of 'fathers,' under the supreme authority of one of their body. Then came autocracies tempered with anarchy, which left to recalcitrants the resource of treason. After that stage the problem is how to devise, through evolutionary processes, the ideal universal government which every one demands, and which as yet, except in books which are the stammering utterance of human artificialities, no one has been able to construct.

I cannot sketch the history of group evolution which under every sort of name has produced conditions of alternately mingled savagery and human fellowships. How can we exactly and truly gauge good will and violence so as to reduce them into dubious compensating formulæ? Group evolution has made us contradictory, and the often uncon-

scious hypocrisy of our conventional language makes it impossible for us to judge ourselves correctly. In the ethnic assemblages of even an 'advanced' civilization, it happens that the most crying abuses are passively tolerated, whereas among races nearer the primitive state (notably among the races of Asia) frightful excesses of barbarity easily go hand in hand with an exquisite kindness in the exercise of hospitality. These facts indicate the varied results of mingled currents of evolution, of which the governing forces clash in contradictory activities, especially when selfish interest enters into the matter. There are many ways of using identical words to express contrary ideas.

No one can describe in detail the different races. I propose merely to note the periods which mark the stages of their mental development. The peoples encamped (often after a migration) in particular regions picked for defense or for the supply of food which they offered; sometimes they were chosen with the idea of making forays upon the neighbors, sometimes as retreats from an attacking foe. These early settlers were alternately conquerors and conquered.

Anthropophagy, a simple question of force among groups of hungry men, seems to have sprung up without revolting the sentiments of the human beast, in contradiction to the proverb that would have it that wolf does not eat wolf. Later, slavery seemed a better way in which to make use of human flesh. 'Social progress' was beginning. Two thousand years of Christianity has not been able to abolish slavery. Only the other day people in America defended it.

I do not want to paint the picture too black. The universe in all its activities is composed of rhythms. The decadence of Greece and the collapse of Rome by way of the long defiles of Christian incapacity none the less led up to that Renaissance of antiquity from which the modern world has sprung. Through our weakness, as through our strength, good and evil days follow one another in an oscillation of regrets and of hopes, big with an idealism too long in coming to birth. Words guide us, but also often lead us astray.

Actions to a formidable extent lag behind the words; and between one people and another, and between one man and another, war and peace continue to prevail, and to add to the vanity of a common fund of joys and of sorrows which exist side by side. Socialists tell us that they are going to change all that at a single stroke. I should like to believe it, but I have my moments of doubt, because in past revolutions I discover chiefly changes in ideological texts, whereas the fundamental man, the man of selfish violence, with his shifts to fraternal love, persists under the disguise of delusive words. We shall change him, perhaps, but it will take time.

We are beginning to escape from class government, but not without great difficulty. 'Castes' and combinations of social interests have, as a matter of history, established themselves in selfish organizations since remotest times for the purpose of perpetuating themselves in innumerable forms, the evolution of which is not at an end. Not having the gift of prophecy, I cannot tell how the great social plasma may, perhaps, break up so many misconceptions and dissolve them in organic forms more in keeping with the general interest. Am I withholding the formula of a panacea? Certainly not, for I see no remedy for so many mingled evils and benefits except in Lamarckian habit based on individual training in an altruism which must be developed independently of the worthless eloquence of sermons that deceive us about ourselves by substituting a clatter of words for action. If, instead of prodigally throwing words about for the winds to scatter, we try to live them, we shall be cured of the worst of our infirmities.

I have briefly reviewed some of our prevailing ideas. I have said nothing of the most powerful emotion of the human race: 'love of country.' For some persons, we must admit, it becomes the text of profitable declamation, in spite of the vain opposition of the ideology of certain scoffers. Let us disregard extremes. The unbreakable attachment of man to his native soil and to the family hearth, beside which his finest sentiments were born and have

grown in a community of feeling and of thought, is the most fitting setting for the evolution of the human race.

Biologically, love of the familiar land in which under gentle, friendly hands we first saw the light of day owns us, holds us, exalts us through everything even to the point of sacrificing ourselves and our loved ones for the sake of a supreme, idealistic satisfaction which will not be denied. Ideologistic metaphysics takes fright at this truth, alleging that questions of patriotism divide human beings whose paramount need is universal union. If such 'reasoners' were capable of observation, they would discover that throughout humanity there have been many more civil than foreign wars, and that the danger of the formation of nations is quite simply that of the insufficiently evolved human mind. On the contrary, the harmony not merely of words but of our deepest feelings cannot but be enhanced by the historic refinement of altruistic sentiment consequent upon the community of feeling produced by a common fatherland. If an integral union of the whole human family could ever be established (which is yet to be proved), the sentiment of patriotism, far from being an obstacle, would be intensified far beyond the extreme of present conjecture.

There is, and there can be, only one solid basis for social action — altruism developed in every aspect of the common life. No matter what happens, a condition of social interdependence is bound to result in coördinated solidarity. The good or the evil that comes from any individual or from any group has definite repercussions on the average mental or moral state of all. Nothing is created, nothing is lost. Hence we can be sure that no effort of ours for the increase of humanitarian living will be in vain. That assurance is what has upheld the martyrs of all great causes, not only the Christians in the circus, but also the later victims of the degenerate descendants of those same Christians, Jeanne d'Arc or Michael Servetus. Evolution magnificently bears all these people to their destiny in an infinite drama of majestic scenes, and we, as we approach death, may well feel satisfaction at having played our part therein.

THE DRAMA OF LIFE

Whatever regulated the original stirrings of our sensibility in the course of the evolution of the faculty of knowing, our need to observe in order to adapt ourselves to the realities of the world was surely enhanced by that amazement which, owing to our primitive misconceptions, so perplexed us until it inspired our effort to reach a scientific understanding of our relationships with a supreme energy. Nothing so tickles our native ignorance as that burst of youthful imagination which, to try its wings, does not wait to make sure of the earth under its feet. The starry dome with its splendor of cosmic fires in never-ending rhythmical motion fascinates us. Even if the world contained no answer, we should still demand to know the why of things, prepared to despair of ourselves if we could discover none of the results.

Sky of day and sky of night alternated, together with the relaxing and the renewing of our energies. What better establishes the bond between the universe and human life? The heavens are as much a home as the earth itself. The first act of our intelligence was to connect the two. Apparently, the manifestations of the elements differed because of size, and, consequently, because of power. Gods, that is, beings beyond human proportions, seemed to exist for the same reasons that we did ourselves, for, like ourselves, they were forms of consciousness living their moment of the universe. Light, heat, wind, rain, and thunder seemed the acts of individual wills, the stories of which mythology has transmitted for such purposes of systematization as we may make of them. That rudimentary outline later became more distinct through the encroachments of experience on the confused ideas that were the result of our bewilderment. But at the heart of our aspirations, there always persisted the search for an harmonious cosmic power which, with ourselves, should create a unified human beauty amid the indifference of space and time.

The earth and its oceans in the sovereign display of their rich energies told a no less surprising tale. Quite as clearly

as did winds or waves, the rocks in their profound vitality taught the same lesson of universal life. India is still covered with sacred boulders to which men pray. One in the ditch that borders the road to Ellora has apparently shown itself so kindly disposed that I saw it surmounted with the dome of a minute chapel — a thing hardly to be expected in such a place.

Quite naturally, man first constructed his dwelling-place, his home, with its many uses, and arranged it with a view to all his needs. He became accustomed to it; he enjoyed it; he loved it; and he became fond of his work before he was capable of disinterestedly admiring the life of the universe. Still later, that sentiment became purer. Between the bestial love of the savage and the delights depicted in the romance of *Astrea*, much road has been traveled. Human art results from an apprenticeship to wonder. We have found the proofs of that truth in the caverns of the quaternary age. It is in the search for the sensation of the 'beautiful' — and in finding it — that occurs the spasmodic action of newly awakened sensibilities, during which there takes place perfect communion between man and the universe, a reunion of the Ego with the world that produced it.

Primitive man had before him long centuries of initiation into the spectacles of nature. If, as Darwin has pointed out, the sentiment of beauty exists among animals,¹ how could man have escaped having a feeling of admiration for form, for color, for the relief and the grace of groups in perpetual movement? He felt it. The perfection of the pictures of the quaternary age (hunting scenes and scenes of family life) have a line that shows the artist sincerely in love with contours amid the complexities of his life. I remember the figure of a horse in which the animal's trust and happy friendliness are expressed with dramatic vividness. Men, and women even more, are almost wholly ignored. The æsthetic aspects of the human form had not as yet become recognized. To a charging bison — an enemy — falls the

¹ The law of organic evolution requires the consecutive connection (in a common direction) of the organic functions in their varying degrees.

good fortune of being represented in finished form. Centuries passed — centuries devoted to the development of relationships in which utilitarian interest as well as intermittent and uncertain benevolence of feeling played an active and a simultaneous part. They were occupied with the fierce pursuit of the weak, and the familiar cruelties of domestication alternated with the effusions of friendship.

I merely note the fact, content to see that from the earliest times there were some choice souls who, beginning with animals, were preparing us to show active kindness towards men.¹ In our pity of things there are degrees of insensibility. We do not observe that ruminants instinctively spare the savory grasses.

Since we were moulded in a purely physiological selfishness, it is not a matter of indifference that an acceptance of the conditions of life, ameliorated as a result of the humanitarian temperament, should succeed in taming the animal elements in human society and prompt us to acts of a relative pity that would raise us in our own esteem. Animals often express sentiment in striking ways. Must man necessarily resign the privilege to the beast? What are scattered acts of compassion, often done in hope of reward, if they are not related to that broad human charity which lifts us above the common verbiage, precisely in its ratio — too often low — to reality?

The first manifestation of the introduction of human sentiment into nature was, perhaps, in that primitive-minded man who worshiped trees,² flowers, groves, and forests, which are, indeed, temples of every mystery, sanctuaries of every emotion. The sacred groves (*lucus*), of which there remain rare traces,³ bear witness to the ancient com-

¹ Descartes himself, at the risk of self-contradiction, was not afraid to recommend mercy to animals. 'Kindness' to locomotives would to-day be the part of wisdom, since it would be to our own interest. When Florian's fox, after preaching pity at the court of the lion, was invited to name his reward, he replied ingenuously, 'Sire, a few turkeys.' He was a fox, and we are men, but none the less his cousins.

² Did the memory of his first dwelling-place perhaps count for something in that feeling?

³ The wood named 'La Folie' at Pauzauges (Vendée).

munion of man with the mystery of things. The legends of the Trees of Good and of Evil are the oldest in Asia. Apprehension of danger is symbolized by the serpent, whose den penetrates to the very mystery of things. By a peculiar favor, man, emerging from the hands of the Creator, finds himself in a garden, the original setting of primitive comfort. The garden is called 'Paradise,' which means grove, natural palace, home of our first joys. What could be worse than to be driven from Paradise and to see the entrance barred by a flaming sword? Ever since that day, the human couple has continued to seek its Paradise or garden, which the ingenuous *Candide* expressly advises us to cultivate.

Alas, there followed interminable centuries of misconception from which man could not free himself without the pain of something resembling an operation for ankylosis. An indescribable stupefaction brings us to a stop before the first living realities of a world which we have persistently misrepresented. Darwin is one of those seers who deliberately chose to accept implicitly every experimental deduction. At each parting of the ways, he pursues the faultless method of tested observation, the inflexible uprightness of a will that will conceal nothing, the loyal replacement of the prejudices of an outworn atavism by scientific data. He awakes in us an overwhelming sense of sure knowledge, and the time is drawing near when even the most obstinately rebellious mind will be astonished at the little weight that attaches to its most inveterate prejudices.

Does any one object to a modest inquiry into the simple question of the variability of species? And if so, why? When the phenomena are fully explained, the consequences will duly follow. Is there not material enough to occupy a life in the invincible attraction of the most arduous problems, in the ambition to measure yourself against scientific facts divested of primitive chimeras for systematic observation? How can we escape doing so? The observer makes a discovery, reveals it, describes it, and goes on his way. At this point our talk should be of familiar things,

such as the plants of our vegetable plots and of our gardens, of our farm animals and of the conditions of their lives, their heredity, their growth, their variations from type, their transformism in evolutionary phases, in the realization of which man himself is revealed. It is the tale of things to which too little attention has been paid, and consequently it is the source of explanations which must be given further study.

The investigator has set himself a task which centuries upon centuries will not see ended. He must learn how to narrow his field. His ambition should not aim beyond bits of demonstration by means of which tentative syntheses may be inferentially set up. Amid the clearings of human knowledge, he should be content to plough his own furrow. Yet the plough is not content merely to scratch the surface. It likes to cut deep. Task succeeds task without ever tiring an ardent perseverance. One proof drawn from life demands another, and then more and more. Observations and explanations succeed one another, and Darwin, stating his 'inadequacies,' begs for criticism of every kind. Meanwhile, the classifications of phenomena multiply and accumulate, opening the way to generalizations the prodigious train of which will not cease while man lives.

The ancient world, with its inexplicable series of species, solely defined by their differences, since no one at first would admit that their similarities had any significance, has passed away. Yes, it is indeed a new world in which we live; it is a multiplication of related lives, distributed in friendly or hostile groups descended from a common origin. How did we fail to feel it and to recognize it sooner? Darwin, whose slowness to reach conclusions was excusable, never hesitated openly to take his stand when through a vast accumulation of evidence his proofs seemed to him complete. And while we were arguing about all the privileges of birth which set us apart under the heavy scepter of Divinity, while the false pride of the upstart still held us fast in the vulgarity of the peasant ennobled under false pretences, Lamarck gave us certificates of the all-inclusive

commonalty which reunites all creatures of the earth in the unbreakable bonds of an irksome fraternity.

Did I not say that the complexion of the world and of life had changed? A new moral state of humanity appeared — a revolution than which our revolutionaries themselves could dream of none more far-reaching. We used to argue about the famous 'Rights of Man,' which, it was felt, the Scriptures did not adequately guarantee. To-day, there is a terrible ebullition of words from which, after blood has been spilt, will spring new terms. We discover that all categories of life descend from the same inglorious ancestors, and we have it borne in upon us that our proud eminence is cosmically rooted in origins similar to La Bruyère's four-footed man.

Meanwhile, in his fossiliferous peace, the man of Chapelle-aux-Saints, indifferent to all that pother, bided his time. He was too near pithecanthropic memories to share the error of man's contempt of his humblest ancestors. From that time on, according to a well-known saying, 'rank will always be recognized.' But the decisive day for humanity was dawning. The duke of Saint-Simon and the unwashed peasant, with their social gospel of earthly inequality, were equally dismissed. While they turned their anger against each other, such descendants of scientists and of philosophers as had escaped the guillotine made ready to reconcile them with a few words: 'Brothers, before you hate each other, learn, if you can, to know yourselves. Perhaps, if you find the leisure and the means, you may in time come to love one another. Until then, begin by paying your respects to your common parents whose common trials caused your common suffering and your common aspirations toward a timid greatness. Judge yourselves according to the measure of things so that you may understand the reactions of your sensibility, which are closely related to the known and unknown activities of the endless universe.'

To-day we need merely speculate in what form the evidence of the ascertained fact will be produced. Of that

revolution Lamarck will be regarded as the Montesquieu, and Darwin as the revolutionary worker who remained unstained by human blood. Alas, the conquests of knowledge, which should be simply conquests of widened comprehension and through it of an increased tolerance, are still, and long will be purchased at the cost of much of that bitterness which is the product of misunderstanding. Indeed, the revolution is already complete in the minds of able men, if not in their hearts. Nevertheless, great is the emotion of those moments in which man, escaping from an atavistic subconsciousness well symbolized by the chrysalis, feels himself thrill with the desire to try his newly fledged wings, even though the original and weak hopes of imagination be disappointed. He may have to forego the desires which he imagined were his purpose in life, but what of it?

Does any one dare claim that to have sprung from the planet and from the universal series of animate things is a degeneration? Degeneration from what? How can we assert that we have fallen from so very high when our sole desire is to undertake an arduous and endless ascent? Whence may we be supposed to have come? From heaven? In old days people conveniently placed heaven above the clouds. But the geography of our blue vault has very much changed since that time. In what nebula, in what milky way, shall we situate that far-off Paradise? I am much afraid that all space is preëmpted. On the other hand, the evolution of life opens up endless possibilities of universal change and infinite future perspectives. Let us accept our sorrows that we may deserve our joys, and that the immense choir of the enthusiasms of feeling, of knowing, and of living moments superior to ourselves may proclaim at the mouth of the dark cavern of insufficiently awakened unconsciousness a quickened desire to understand.

True it is that life is a battle-field on which fearful blows are exchanged in the dark. What right have we to complain when man, ever since his appearance on the earth, has taken pride in the increased extent and violence of his wars? He acclaims peace and even persuades himself that he

wishes it to endure, yet he does not wish it strongly enough to maintain it. What good does it do to complain that the universal competition of existing creatures makes the unchecked struggle of forces inevitable, even though some forms of that struggle may be mitigated? Man inscribes the too facile dreams of a verbal idealism upon walls which the public passes by unheeding. And yet amid the vanity of power, amid the sterility of regrets, the intellectual life in its superior evolution still triumphs over all the shortcomings of mankind.

As a calm spectator, Darwin contemplates the unlimited extent of the universal slaughter-house. Far from admitting that the fatal law of the struggle for existence can be changed, he tries, like many others, not to complain, but to hope for vague attenuations. It is for the scientist to provide that state of mind, the result of scientific knowledge, which some day perhaps will permit us to grapple at closer quarters with the objective phenomena of the Cosmos.

By verified observations, Darwin puts us back into our natural place among the modest progeny of our humble ancestors and strengthens that sentiment in which is revealed the sweetness of that reciprocal charity by which the pulpit lays more store than does the hypocrisy of private life. We may assuredly and properly argue that life is legitimate. The life of the shellfish is no less legitimate than our own. Nevertheless, the oyster does not come to our table as a guest. We feel no compunction in making an oyster our victim. On the contrary, we exhibit a subversion of our capacity for feeling. Swallowing an oyster alive or even squirming from the condiments with which we cover it, and eating a bleating sheep, which we prefer cooked, are only degrees of insensibility. When hungry, our brothers the Fuegians and the Polynesians (whose 'soul,' like ours, is compounded of a divine essence) even to-day butcher their old women. In lifting us from the fallen state of the Bible in order to put us at the head of the hierarchy of living things, Darwin not only made us amends, but bestowed upon us a quasi-legitimation. And this he did by crediting us with the vague

beginnings of a relative charity inconsistent with the deliberate tortures demanded by an implacable Divinity.

To the Indian peoples, which had the privilege of extending the original avenues of light far beyond the point that other migrating races attained in other climates, fell the distinguished merit of conceiving a universal society of living things, and, through an astonishing boldness of vision, of daring even to establish an organization to that end. That was the famous system of metempsychosis of which Vedism and later Buddhism made magnificent use. Its basis, as we all know, lies in a succession (an evolution) of forms of existence in which man — necessarily included among them — rises or falls in the scale of his fellow-beings through an ascending or retrograding transformism, according to his 'merits.' Hence came the command, 'Thou shalt not kill,' for, in so doing, you will sooner or later lift your hand against an ancestor, or at least aggravate the sufferings of your own kind. I have described the empirical attenuations of a strict adherence to the rule. At the bottom of an Indian's heart there remains the feeling of a general communion of creatures which dominates his outlook on life, begets actions of charity, and ennobles him in his own eyes. On the other hand, the idea of punishment and reward which our remote ancestors were bound to connect with that teaching necessarily debased the admirable prescience of the natural interdependence of all the related forms of life to a form of ultimate selfishness. The sentiment survived and later became purified. A man who takes care not to crush an insect on the road will not generally be cruel to his traveling companion, whether animal or human.

Alas, in order to live we must at every moment destroy innumerable lives! No religion, no doctrine, has been able to change this inevitable fact. The constant preaching of divine charity has produced showy but inadequate results. However, the great universal pity for living things touches the deepest fibers of our inconsistent sensations, which at times fuse into coherent outbursts of fraternal feeling.

One of the legends about Buddha tells of his offering his body to a tigress whose cubs were hungry. We need not fear that we shall so strictly adhere to the doctrine as to do likewise.

Does that justify the unfeeling repudiation of the poor relations whom, alas, we habitually abuse? And, what is more important, does it justify our lying to ourselves when we can just as well tell the truth, yet lie because, like hard-hearted children, we think it grown-up to be ungrateful? Remember that even Christ said to his mother, 'Woman, what have I to do with thee?' The time has come when a new state of mind becomes apparent. Scientific knowledge, in opening our eyes to the proofs of common descent, has brought us back to that feeling of fraternity from which a snobbish affectation had too easily turned us away. After centuries of unrest and woe, the prodigal son, knocked from pillar to post and reclaimed through the trials which misconception brought upon him, abruptly appears at the gate of his father's house.

'Brothers, who seem so afraid of me, here am I before you. Since the day when I undertook to outstrip you on the road leading to a new fortune, I have lived a life variously composed of good and of evil. Beneficiary or victim of the urgings of ambition, I have abandoned the footsteps of our common ancestors in which it was your lot to follow. We cannot escape from the law which decreed that we should have different destinations. Both you and I followed the inevitable path; you, confirmed in the atavistic course of action from which you were unable to depart; I, with great stir seeking improved conditions resulting from an empirical knowledge as presumptuous as it was powerless to repair the evil which our "natural gifts" lead us to commit.' When we take the life of one creature in order to prolong the life of another, do we perform a good or an evil act, or is it an act which is merely inevitable? I dare not ask. Up to the present time the weak get off with submitting to violence, whereas the strong are inclined to celebrate their magnanimity.

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'I do not suggest that even with your help, I can establish the true value of things in these difficult mazes. I should not dare to try. It seems to me merely that, according to the ancient custom, we might send to each other, each from his own camp, the salutation of those who in any event are about to die. However proud of itself our human kind may be, it has, with its open or latent anthropophagy, let loose on the earth far more evil than have any of your tribes. In spite of that, we aspire to do the greatest amount of good. It is not our task to reconcile the terms of an antinomy which is not of our making. Indeed, we daily pour ourselves out in hyperbolical praises of the supposed instigator of the universal massacre.

'Would that the evil we cause resulted from an inability to do better! Have we not preserved between us enough of a common heritage of sensibility, active or passive, so that an echo of it sounds in us and can be ennobled by disinterested emotion? We dare believe that a future which will perhaps be better awaits us. Be indulgent to man, and we, if it does not sound too ironical, will preach, as opportunity presents, "kindness to animals."

'Long excursions into the field of evolution, which I cannot regret, have taken me far from you. A conscientious observation of the world and of myself has brought me back to you less proud of my faults, more sympathetic, better, perhaps, if I may dare the conjecture. Of the power which I have conquered over things and over lives and for which I have paid the price, I wish to make the least harmful use — the results I leave to the irresponsible universe. The familiarity of domestic life over a long period of time has brought our hearts together; between outbursts of violence and of savage cruelty there have come hours of reciprocal "taming," which from time to time have made us companions. When I have come into contact with the fragile feeling which indicates the existence of the fraternal bond, I have been keenly aware of the number of trials endured in common, and I have felt that my ideals had become higher by the effect of a more intimate communion

with all the lives of which I am a transient element. Men are false to one another. Dogs have remained faithful to me. Sometimes I ask myself whether I have deserved it.

‘For good or for evil, we are governed by the same inexorable laws. To come down to facts, have we any valid grounds on which to reproach one another? May it not be our highest destiny simultaneously to fight and to love each other? May not softening the asperity of the struggle through intervals of respect and even of affection among the different living families very much resemble what we and our fellow-humans call “world-peace”? Yes, that “peace” which we cannot offer you, we desire and preach among men. Our temples resound with it. See what we have made of it. War is still very close to being our natural state, and peace is too often an organized cruelty. I no longer speak to you as the old-time agent of Divinity, since I seek, however ineffectively, to go against the current of fate.

‘Our lot is one of cruel joys at each other’s expense, offset by a vain pity for those who can defend their lives only by taking the life of their neighbor. You yourselves who so justly complain of us do not spare one another, and our superior strength obliges us all to destroy — with or without pleasure — everything subject to our law. Such is the sanguinary drama for which a just Providence is made responsible, whose only real responsibility lies in merely having suggested the idea of inscribing rules of procedure on the doors of slaughter-houses. And yet, is it not true that our distinguishing quality, which is our ability to comprehend, opens for us, men proud of the name, who are lamentably cruel, the door to incurable suffering? The reason is that in doing evil we have the misfortune to know it, yet can do no more than mildly alleviate it with words which do not even dull the edge of the murderous mischance. Pity me, then, my brothers, for being more consciously wicked than you and envy me, if you can, for aspiring to a better state. Our fate is to be both executioner and victim. Our misfortune lies in our inadequate charity in which a too facile com-

passion for our victims is mingled. I should like to find in you something of my own pity for myself and for others, just as you find in me and in yourselves uncontrollable reflexes of ferocity. We have, however, one consoling thought: we are neither of us responsible for our destiny.'

Lamarck and Darwin were occupied with other matters. They were eager to overcome the opposition of that deified abstraction which science could not include among the co-ordinate laws of the universe. Darwin, aware that he had established his positive proof, the result of observations scientifically indisputable, took the risk of promulgating, though in conciliatory terms, a general view which no one has been able to contradict. 'When I consider all living creatures no longer as special creations, but as the direct posterity of beings that lived long before the first strata of the Silurian age were deposited, they seem to me suddenly ennobled.'¹ Just as he was finishing his book, an idealistic synthesis of a subjective reconciliation among the forms of life enabled him to perceive the nobility of his teaching and to end his work with these words: 'This aspect of life contains an element of grandeur.'

At this point, indeed, we become, and are, the principal characters of a drama which is greater and more moving than anything we can imagine. The stage is infinity. The protagonists are the stars, with their monstrous conflagrations and their immeasurable cycles, supplemented with an emotional consciousness which assures the success of the play by supplying an audience fortunate in its ability to feel and to think. That interested spectator, man, to call him by his name, did not arrive of his own accord as we enter a theater. He was not formed; he knew nothing of himself, and he came to understand only after that long evolutionary progress from a state of organic sensibility which carried with it those reactions of mental association the linking up of which created present-day feeling, thinking, and judging humanity. Since he was undergoing an in-

¹ Last pages of the *Origin of Species*.

cessant evolution through successive stages of sensibility, his points of view, his interpretations, his inferences, necessarily expressed themselves in the form of relationships which allowed him to define what he felt, what he tried to anticipate by means of hypothesis, and whatever in the transient objectivities of the world he failed to grasp.

Now that the gods have vanished, man must find in himself the courage to face alone the forces of the universe. Far from losing interest, the drama will become the more impressive. It will be so vast and so marvelous through its contrast between the elementary organism and the infinity which opposes it that we shall be thunderstruck.

From now on man will be accountable only to man, which is more than the gods ever told us. The drama will pass from a divine fairy tale to a narrative of purely human activity in which man tests his strength upon himself within those limitations in which the tumults of the universe confine him. There is no other spectator, no other critic, and no other judge of man than man himself. Man must define the limits of everything which he can grasp in the universe in order to mark out the broad avenue of knowledge, and he must assign the events of his life to their due place and bring them into adjustment.

Yes, man at grips with the universe! How the interest of the play is enhanced by the disappearance of the divine autocrat, who leaves to the player of the secondary rôle the serious obligation of taking the leading part. Gone is the tyrannous master of the stage, with his hackneyed climaxes. Finally, human weakness takes the center of the stage. It is still stiff in every muscle from its fetters, but is freed by its own effort, and as a reward for that effort the jealous future still holds some treasures of the unknown. There is place in the play for every tragic accident.

The Cosmos does not worry much on that score. Yet from our point of view, the prodigious happening excites and summarizes our keenest emotion. It presents the question of what our future is to be in the most tragic form in which it can be evoked. It is only a very short time since

we found ample consolation in deceptive words. What, then, did the world of the primitive ages have to offer us? It offered the picture of imaginative suppositions, the chief attraction of which was that they so marvelously fitted in with the aspiration, the hope, and the ignorant contentment which stimulated us to undertake the task of investigating.

In an age when the spoken and the written word were invading existence, few people troubled to disentangle the more or less verified observation from the emotion which often distorted it into the semblance either of fear or of consolation. Nevertheless, that disentangling determines the correct or incorrect purpose of our lives, since, taken as a whole, it implies the right adjustment between understanding and sentiment.

As far back as we can trace the activities of our sensibility, we see that we have been controlled less by the bold reasoning of which our history boasts than by emotional impulses which are prompt to drape themselves in theories made to harmonize with anticipated conclusions. From that point of view, it is much more the emotion of the world than any cool correlating of experience and its extension through hypotheses, whether verifiable or not, which releases the feelings that determine our action. From the man of Chapelle-aux-Saints (to go no farther back) to Galileo or to Newton, various emotional impulses stimulated progressive advances in knowledge.

Thus, into the very conception of the drama, together with the dramatic values of inevitable conflicts, there crept many changes. Personified omnipotence and its spasmodic authority became powerless. It was relegated to the rank of an infinite activity of a determinate unconsciousness which with the aid of our organic reflector happened to bring about the representation in consciousness of transient aspects of the Cosmos. Until recently we considered ourselves the feeble subjects of an absolute autocracy; to-day we see ourselves temporarily promoted to the status of representatives of a passionate personality, the power of

which in respect to the aims in which our aspiration loves to embody itself never ceases to grow.

That the emotional interest of the climax is singularly heightened goes without saying. A theater audience manifests its sentiments differently according as the end of the play is happy or unhappy. What credit could the priesthood have found, if its piece had not offered easy satisfaction to the naïvely credulous? If the literary fiction of the cosmic drama is such that we can be satisfied with a divine altruism which results in tortures, what transformations, what outbursts of emotion should greet the end of the tragedy of a day in the cycle of eternity! After having proclaimed ourselves the images of the supreme God, it is certainly a disappointment, after the intoxication of that plaster of Paris apotheosis, to find that we are mere sparks of fire. But what a renewed joy we shall derive from a hand-to-hand contest with the Cosmos during which, were it but for a day, our consciousness shall formulate the laws of infinity.

Man, in his struggle not only with the universe but with man, must, whether he finds it agreeable or not, remain subject to the vicissitudes which the law of his organs — a law from which he cannot escape — imposes upon him. Since the universe contemplates with equal indifference the collisions of atoms and of stars in the Milky Way, it is pure childishness to try to dictate to it such an issue as humanity might prefer. Since nothing is stable, and since everything continues, the primal cosmic law is that the universe has no issue.

When man's mental evolution is accomplished, will he, who above all loved the soporific drug of theological myths, be strong enough to undertake, unassisted, the rational direction of a life the reality of which is absolutely opposed to his obsolete hopes? The problem has been stated rather than solved. The official Providences of all the cults have obviously failed in the mission which they arrogated to themselves. Still strong in the verbal authority of the priesthood, they no longer respond to the deeper needs of

an enlightened intelligence. Soon we shall turn for support only to positive experience, and that experience, lord of thought, no dream can dominate.

As a matter of fact, men's decisions and undertakings are based on a succession of sound or unsound emotional impulses. Of those undertakings is not the noblest, the most urgent, and at the same time the most doubtful, the task which each of us has of knowing himself well enough to guide his own activities? The remark is not novel. Long ago the solar god of Delphi advised man to know himself, but neglected to tell him that he could attain self-knowledge only by first attaining knowledge of the universe.

At this point the preliminary problem presents itself of knowing whether, contrary to scientific observation, the universe is made for human ends, or whether man is not merely a transient incident of the infinite Cosmos. The answer cannot be left to our emotions. Verified experience must, therefore, give judgment — whether that judgment pleases or offends the æsthetic taste cultivated in us by our primitive conceptions with the ensuing consequences.

Man's desire for knowledge is irresistible. And to his knowledge, such as it is, he must adapt himself. The sensations he derives from his primitive life should not interfere with the scientific knowledge which assigns him to his correct rank. The prophecy of an event is no guaranty of its occurrence. The day, then, will inevitably come when in the succession of related forces man, phenomenon of space and time, will complete the circle of his evolutionary stage in that ocean of infinity from which he appeared, only at once to disappear.

A gleam of idealized sensibility seems of small account in terms of the universe. It is no less true that, according to the classic epigram, I am subjectively superior to the universe which crushes me though I know, and it does not know, that it is to crush me. I realize that there is no objective superiority, since in the universal chain all phenomena are of an identical value as links. Nevertheless, the fact that the universe is reflected in my consciousness, and that I

react to it sensorially and intellectually, remains the chief phenomenon of my existence. What is concerned in this matter are the relations of the Cosmos, that is, of the infinite, with the relativities of the complex of elements which constitute the individual.

The mere idea of any issue such as that with which our ancestors began their structure of things contradicts the eternal autonomy of the elements. The supremacy of the infinite imposes itself on all the forms of life which are transiently scattered through space and time. We continue to cling to the ingenuous hope of finding variable forms that nevertheless are permanent. To oppose the universe in that form is, properly speaking, to substitute ourselves for it. Between the universe and ourselves there can be — and this is marvelous enough — nothing more than alternate accords and discords in which the last word unquestionably remains with the potentialities of the Infinite.

And is that all? At least it is the irresistible cosmic event, the law of all life, to which, whether we like it or not, we must adapt ourselves. We should neither lament nor boast. We should understand, and, to achieve our highest development, we should make ourselves worthy of our lot by struggling to the end along the path which leads to the resolve to help one another and to live in fellowship with one another. I do not say that there will follow from such conduct a *satisfecit* between man and the universe, since that would require that things be accommodated to the varying fancies of each individual. But, how can an individualized human sensibility either praise or reproach an unconscious infinity to which, since it has no limits, the synthesis which we know as individuality is impossible? When our turn to be born comes, we are projected into life. What other resource have we than to adapt ourselves to it?

Our fate is to be admitted to the consciousness of things with the consequent sensations of pain or of pleasure. To this there is no just offset, but apparently the resulting impression is favorable, since every one wishes to live and to continue living. Is it not foolish for us to debate

whether we shall do fate the honor of being content with our lot?

In reality, sensibility, lord of the activities of our lives, with its effects of pleasure and of pain, is organically so strong in us that we cannot make up our minds to give it up. Sleep, the absence of which we deplore, frightens feeble minds if unaccompanied with the promise of an awakening. When it comes to accepting the primeval uncertainties of that death which separates us from all we love, even the anticipation of sovereign relief does not do away with our regret at leaving the turmoil of life. Born of unconsciousness, we do not willingly return to it. And yet man, freed from the chains of his gods, can rely only on himself for the accomplishment of his destiny. Manly effort, with the aid, as Kant said, of that 'fruitful illusion' which is too often necessary to the noble adventures of thought, is what brings out the best that is in us.

The world is a trial of strength. To be wholly successful, we must temporize. The alternatives are to battle to the death or to surrender at discretion. Such are the limits within which man develops, helped by habits which permit him to endure the test. Whether we revolt or surrender, we must live under the obsession of the evil or the good which our sensations bring us. Man is the plaything of all contending forces whether disguised as crude or as refined myths; he is an implacable destroyer of lives kindred to his own; he is halfway between his gods and the brutes and, as I have pointed out, presents two aspects — that of victim and that of executioner. He is a Janus-faced being who in spite of his idle talk of brotherly love, has to be at war with the multitude of living creatures, not excluding those of his own kind, at whose expense it is his fate to live.¹ And this

¹ I am not even very sure that between *Pithecanthropus* and the man of *Chapelle-aux-Saints*, some intermediate men did not relish the flesh of their own young offspring, a habit which survives among present-day carnivora and rodents, without the excuse of hunger. The fable of *Kronos* devouring his children so habitually as to prompt the ruse of *Hera*, who substituted a stone for the newborn *Zeus*, perhaps indicates the persistence of old memories. When, on the express order of *Jahveh*, *Abraham* made ready to immolate his son, is it any mitigation of the paternal murder that he had no intention of devouring him?

situation was to continue until there arose those humanitarian 'attenuations' which led from cannibalism to slavery. The emotions that rule us under the empire of more or less happily coördinated sensations are in different degrees common to us and to the whole animal series, the members of which are dominated by those stronger than themselves and dominate those that are weaker. We hardly concern ourselves about the matter, since, *temporarily at least*, we are the stronger. Moreover, if to our weaker animal kin we are divine (that is, not to be overcome by force), they themselves in the measure of their strength no less inevitably combat one another and kill one another. The chief difference is that, except in the case of man, the emotions common to all members of the living series do not attain a power of interpretation great enough to permit them on contemplating the world to entertain any wish to hold a rank higher than the one that is properly theirs in the correlated universe.

Thus the drama is complicated by the more or less correctly regulated reactions of a human sensibility carried to the point of becoming an emotional resonance — whether discordant or harmonious. The emotional conflicts which arise from the shock of different, or even of contradictory, interpretations represent the point at which bursts forth the noble yet cruel splendor of our humanity. It is the prey of shifting knowledge and misconception struggling to reach emotional adjustments. How much better we could realize our ideal selves if word and deed were not so far apart! The delight in words is so great that the value of the underlying deed is forgotten, if not destroyed. What relation do Christ's words of love bear to the tortures and the massacres which have seemed their natural translation to the 'Christians'? What relation can there be between Voltaire, Rousseau, Montesquieu, and Condorcet and the Tribunals of the Revolution, or with the law of Prairial? What fine books we have on human charity! What empirical commentaries on our brutishness!

Such is variable man, as he oscillates between gentleness

and ferocity. To justify such variations even egotism requires the melody of an idealized music. The remorseless need of organic renewal which the evolution of his life demands cannot help but maintain his feeling of indifference toward the organisms whose weakness makes them his prey. The universe is what it is. We must conform to it. In contrast with the divine hypothesis, which makes evil inexcusable, the justification for the cruelty of the Cosmos is that it is not premeditated.

Pains and pleasures, sensations of cosmic resonance or discord, reciprocally imply and condition one another. We may bless or curse the reactions of our sensibility, as occasion may warrant, but without them life would be but an arrangement of Cartesian mechanics which made no use of results. What can we do with our associated sensations if not arrange them and coördinate them in those classifications of relationships which constitute knowledge, and which, when classified, direct our conduct?

At one extreme we have the original thrill of obscure sensations in the mono-cellular organism. At the other extreme, we have the development of human investigation, ever asking questions. It is a dramatic dialogue between man and the universe, which is undertaken to harmonize their energies, and in which simultaneously appear the tradition of ancestral misconception and the innovation of experimental rectification. What will it accomplish?

In our short lives we wish to feel, we wish to know, we wish to put our own emotional nature into things; to be moved by the beauty of the universe and by our own beauty. But what opposition must we meet, what battles must we fight, in order to overcome the obstacles of our successive heredities and to trust ourselves to the organic promptings of our being amid the agitations of that social environment in which our confused energies are swallowed up!

Tumultuously the drama unfolds. Man would like to be independent of the universe of which he is a fleeting incident; instead, he impetuously throws himself under the yoke

of primitive misunderstanding, from which he dreads to be released. Such is the obscure conflict of every human life, a conflict of which each of us speaks as little as may be, perhaps because he feels its effects too keenly. Until we can overcome hereditary inhibitions we must accept the fact that an intellectual minority will continue to battle against an uneducated majority which becomes more hostile as it meets stronger opposition. Nevertheless, the day will come when Lamarckian habit — that is, fit mental training — will bring us the just compensation of finally permitting us to bequeath to our posterity a capacity for free growth.

So long as we remain in the murky confines of primitive heredity, we must inevitably wound the atavistic man to the quick when, instead of 'revealing' to him that the animal world has been given to him, like trees or stones, to be used or abused at discretion, we tell him that his own life is nothing but organic coördinations which, by heredity, are a part of that very succession of inferior organizations which he professes to despise. How completely such an idea must upset his point of view! Under a divine autocracy to be conciliated through prayer, he was the 'King of Creation,' and now people tell him that he is actually descended from the inferior types that were destined to be his slaves. His mind rebels, his sentiment revolts. Yet the enslaving of our human brothers whereby we began our civilization shows that the question of our origin troubled us little, since we reduced to servitude — that is, made brutes of — those of our own race as well as all captives of a different ethnic strain.

The scenes of the drama pass in succession. Some one has spoken of 'a degenerate Adam, or a perfected ape.' Whoever traces back his ancestry too far runs the risk of surprises. Pericles is relatively of yesterday. I should like to see the ancestors of the apotheosized Louis XIV who lived in the days of Pericles. Had 'le Grand Monarche,' peruked and plumed, been brought face to face with his Periclean forbears, he would not, perhaps, have been very proud of a stock which, nevertheless, in its later branches, he

valued so highly. The primitive Gaul, the contemporary of the aurochs, of the great bear, and of the wild boar, also had remote ancestors to whom he gave no thought, and of whom he would not have been overproud if he had happened to meet the man of Chapelle-aux-Saints, now recognized as an authentic specimen of primitive man.

Shall we retrace the course of history to the primary deposits of the quaternary age, passing in review, age by age, the original forms which constitute the various stages of the animal series? Never shall we encounter the Biblical ancestor created by the wave of a wand, but in his stead only specimens of incipient humanity among whom the man of the stone age would pass for an Apollo. Soon, indeed, we should run against the Javanese *Pithecanthropus*, a far-off ancestor, at the peak of an anterior zoölogical series which the records link directly with the more than humble ascidian. Ye masters of metaphysics, where does the human phenomenon begin or end? What was the state of thought and of language in the day of the Neanderthal man, or in that of the man of Chapelle-aux-Saints? Are you quite certain that you can place an immortal soul anywhere in the long line? What sort of soul would it be, and what would it accomplish? Did the psychic miracle occur before *Pithecanthropus* and his race, or later? How do you know?

Assertions based on experience are, as I have said, often rectifications of imaginative views provisionally set up for discussion, as is shown by hypothesis, where conjecture guides us by becoming the subject of verification. The ideal, without which this harsh life would contain nothing but positive fact, is made up of subjective anticipations of an unverifiable progress. We necessarily began with an ideal which we could grasp. In this manner we tried by means of the creations of our imagination to anticipate the slow march of verified science. The continuous subjective evolution of an imperfect ideal that far outstrips the progress of science, is what makes human life so incomparably fine. The aspiration toward an ideal which never ceases to change and to grow finer in us through the progress of

knowledge and the dissemination of the nobler feelings, represents the most remarkable effort of human life. And that aspiration is so fine, so unconnected with the universe itself, that the majority of men gladly postpone critical examination of it to an indefinite future.

‘What!’ some persons will exclaim, ‘do you mean to tell us that our ancestors, who accomplished so many and such great things, lived and died in error? Our fathers’ gods did things which we would not do. Should we be so bold as to claim that we have outgrown them?’ The ideal has assumed successive forms, each in turn inspiring us to nobler conduct. It is quite true that our fathers constantly proclaimed the permanence of their ideal, as we proclaim the permanence of our own. How can mere statements affect world movements which, more or less faithfully interpreted, open up for us the whole limitless future?

Although the finest acts of heroism have been done in the name of an ideal which has not always withstood the test of time, of what importance in the continuing universe can it be that human views, which are purely subjective, have been modified in the course of the ages? Under whatever god may be, to live uprightly according to our lights should be the aim of every one. There is greatness in wishing to know more and more in order to live better and better. There is greatness even in going astray in an ardent search where we have no other touchstones than our relative definitions. Putting aside the absolute discrimination between the true and the false, which is beyond the power even of science, a vast field still lies open to our activity when, left to our own resources, we dare to demand an accounting from the universe and even succeed in wresting one from it in return for reciprocal concessions.

If the ordinary man ever succeeds in rising — and the task will be difficult — above the puerile bait of reward and punishment, the nobler emotions which would then be his might, as happened in the case of the heroes of antiquity, raise him to the calm, perhaps even to the enthusiastic, acceptance of that suffering which the fanaticism of a dog-

matized ignorance inflicts upon him. Do not the Christians slain in the arena and the arch-heretics massacred by the orthodox Christians stand out as equally fine examples of human nobility, according to the false empiricism of their contradictory causes? It is less the exactness of man's relative knowledge which characterizes the perfect man than it is the growth of that unselfish feeling which raises him immeasurably above the common herd. The essentially simple idea of defending the fatherland was enough to make Jeanne d'Arc immortal.

Moreover, battle is no longer the sole arbiter. The still small number of intelligent people daily increases and strengthens our hope, so often disappointed, that an ideal evolution toward peace is yet possible. The masses learn slowly, and they act stupidly. Brought face to face with a dreadful Cosmos and the tyranny of error, the man who seeks to know no longer feels himself to be the butt of public abuse. He has fellow seekers. He counts victories the scope of which daily expands. The time is approaching when he will be his own master. The opposition of the dogmatists, supported by hereditary instincts, will keep him under the obligation of giving the utmost of himself in his efforts toward the noblest of all works of liberation. His success or failure will depend on the degree of steadfastness which he can bring to the task.

Scientists who rely on observation confined within the limits of an experimental study which compels them to contend with the indifferent or hostile universe, can rely only on themselves. They are great through the pride of a courage superior to all failure, whether apparent or disguised. Such a rôle cannot be the lot of the masses, among whom courage and even heroism is more common than thought. Mountains overlook valleys. To climb the peaks, we must be adequately equipped. Is that the same as saying that a magnificent example cannot arouse the enthusiasm of the masses seeking enlightenment? Quite the contrary. But the great majority will not decide until after the battle is won; and to be a real conqueror — that is, to capitalize suc-

cess — a man must have fought. The evolution of man must run its course through the transformation of ignorance into knowledge and of incoherent emotion into right feelings. This in itself is a mighty task!

Indeed, what makes a man is not that hollow 'success' which fascinates the smaller fry. Nor is it the puerile 'pride' of a social distinction decorated with the ribbons of its 'honors.' What makes a man is a mind well balanced in those faculties which in combination make possible an effort to attain to a higher subjective state. The most learned of scientists, however, will never win more than admiration, whereas the high emotion (with no scientific basis) of a Buddha or of a Jesus will, at least temporarily, move the masses to disinterested action.

I have in mind that maximum of emotional life which attains the lofty but unstable power of communicating emotion. That is the supreme achievement of the man tormented by the desire for knowledge, and eager to spend himself in the pursuit of an ideal which he hopes to realize. That is what under different names captures us, masters us, keeps us! And generally we pick the form of our ideal blindly and according to momentary fashion. Evolving in us, the organic potentiality of our ideal of beauty blends with our weaknesses, as it does with our strength, and ends by charming us with high-sounding words which at best are but the asymptotes of reality.

To give the ideal concrete form under the name of Divinity was the result of a first attempt within the scope of the comprehension of every 'mind,' until the day of controlled and verified observation dawned.

To-day the ruling God, under the repeated assaults of experimental science, is crumbling away into scraps of outworn idealism. In an impersonal form the ideal may at first seem less effective, and, for a time perhaps, may be so in the case of people whose consciousness has remained simple and undeveloped. That is not so important as it seems, for a verbal idealism casually dispensed by an unknown Providence was never more than a cloak of barbaric

magnificence to disguise the poverty of human imagination. Neither hell nor heaven has succeeded in establishing among us standards of a higher order than those of people who, like the Jews, expected nothing from another life. With the aid of words, any one can conform to the exigencies of precepts by 'interpreting' them; and of interpretations there is no end! Consider the 'Provinciales.'

Contrary to what might be expected, a wholly depersonalized ideal may well react more powerfully on a higher form of culture than have all the myths of antiquity. In the emotional average of our common lot there are more opportunities for maximum disinterestedness than we have chosen to believe. The man who with serene heart yields to the fatal necessities of the human state will need no verbal tricks to make the finest use of his life. The Sphinx will not frighten him. He will meet it face to face and will ask it questions before it asks them of him. He realizes that he is immersed in the universe, but when he ascribes the reactions of his own sensibility to the unconsciousness of things, he finds in himself a momentary power of judgment which in the profoundest depths of his being sets in motion elements of the God whom he had believed he saw outside himself, and whom he tries to realize within himself by the reflection of a reflection. He pronounces judgment; he proclaims the Cosmos; he proclaims himself, and, comparing one with the other, formulates the famous 'last judgment' which his Divinity, on account of an inadequacy demonstrated throughout the course of centuries, instead of pronouncing, undergoes. He makes his own affirmations; he acts. It is a transfer of apotheosis suited even to simple minds when Revelation has been discarded.

It may be claimed that this ephemeral victory is imaginary and subjective. What, then, is it that made the temporary strength of the different theological systems if not the uniformly subjective satisfactions available to him who can take incongruous chimeras for objective forms? Indeed, what is this same subjectivity if not one form of the general objectivity of the Cosmos? Let us pull things apart

in order to understand them, but let us put them together again when our aim is synthesis. At bottom, the universe is only a phenomenon of infinity of which man represents a momentary aspect. How can the fact that for a single tick of the clock he seems ruler or ruled change the double fate of birth and death? And how can he complain if amid a tempest of things known and dreamed, indescribable combinations have decreed that he be dazzled with the super-human?

I have tried to show some of the things which lie beneath, within, and on the surface of the immense drama in which we are at once actors and spectators. It would have been a waste of time had I sought to deal with the action as a whole, since that whole is the eternal infinite. I have tried to throw light on certain of its aspects by turning on it the light, such as it is, of my modest reflector. That is precisely what the masters of past ages have gloriously accomplished; and what the masters of the ages to come will even more gloriously accomplish. My purpose is to annotate particular passages of the drama — a purpose which does not prevent a rash effort to present a coördinate view of the whole. The actor and the spectator who are blended in me have a right to the same æsthetic and scientific satisfactions, both of which will inevitably be supplemented by imagination. Each of us, in his rôle of spectator, will be most exacting. Engrossed with his acting, the actor will be less so. The confrontation of the two masks is a subtle climax which is not, however, an end. Moreover, is it certain that the best critic will be the moralist who can most completely 'lose himself' (as the phrase goes) in the character he is to act? To analyze your life requires a tremendous effort. It is even finer to lead it in the paths of righteousness. Nothing so surely guides us along the right path as an honest desire to do right.

The drama unfolds in a whirlwind of forces. The transient scenes with their successive emotions constantly renew themselves in the essential unity of the tragic personage which life and its reactions present in various shapes. The

same fundamental dramatic action inspires the 'hero,' modest or grandiloquent under his theatrical mask, throughout the shifts of the plot. To be sure, he is more often moved by the applause or the hisses of the gallery than he is by his estimate of his own performance, which ought alone to influence him. Since each of us is primarily concerned with human life, the Gordian knot of our existence will not be cut, whatever we may personally decide. Man is the result of improved knowledge, and man's task is to maintain the quality of the emotions which flow from that knowledge. Indeed, the interest of the dramatic action will be the keener, and, like heat lightning on a dark horizon, splendors will appear only to disappear.

If we appreciate the rôle we are to play, it behooves us to pay careful attention to this snap-shot of life. What the attempt to introduce ourselves into the frame of the infinite, which sorts not at all with frames, does for the disorders of humanity our history has clearly shown. The finest verbal altruism has been transposed into sanguinary orations. Behold, if examples are needed, Bossuet celebrating the Revocation of the Edict of Nantes, and the priesthood of our day, forgetful of its former burnings at the stake, gravely making itself the uncompromising champion of 'liberty.'

According to the scientific formulæ of the world and of man, as we can begin to define them, the life of the individual finds its highest achievement in that mutual helpfulness which impels the strong to succor the weak, and the cultured mind to enlighten the clouded intelligence. Each has his duty, even though it may, alas, be concealed beneath vain words! Whoever finds himself able to stand erect can, and should, because it is an unselfish act, help to lift another to his feet. The individual effort to do right in order that the world at large may benefit will never be in vain.

How can we, then, interpret as a degradation a humbleness of origin which, on the contrary, should raise us in our own esteem through pride in our superior development? Is

it debasing to decline the spurious pomp of the tinsel of a semi-divinity in order proudly to take our place at the head of a cosmic hierarchy of conscious beings constantly growing more enlightened? A friend of mine, who is a great landowner, was one day asked at his own table what his father's occupation had been.

'My father,' he serenely answered, 'was a chimney-sweep.'

His remark was greeted with general admiration. What better retort could be made to the snobbery of metaphysics, too haughty to admit relationship with our Javanese ancestor?

In order to recognize his proper place in the positive activity of the universe, any man who loyally tries to comprehend and to live his own life should, and must, close his ears to the childish legends of a past which was ruled by a vagabond imagination. There are grades of idealism, and they represent stages of past and future evolution. Let no one, then, be astonished if the 'ideal' of the pallid sycophant of Divinity cannot harmonize with that sensation of exceeding pride which is the high reward of him who faces the actual world and who rises above contingencies by his own will-power. We are far indeed from the prophesied decadence. The practical value of an ideal is determined, not by the wordy clamor which it inspires, but by its efficacy. Legends and myths have stirred up a great altruistic to-do, but instinctively we were selfish and malfeasant, although we vainly tried to disguise the fact.

Constantly more unattainable, the human ideal, purged of all the baseness of contingent rewards or punishments, must stand squarely on a platform of cosmic reality if it is to rise to greater heights. An idealism daily embodied in our deeds is the most splendid product of our inconsistent lives. To attain the fullness of well-ordered living we need the very best that is in us, inspired by an ideal and touched, as a wise man said, with a faint tinge of madness.

CHAPTER XIII

THE PRIMITIVE AGES

THE PROCESS BY WHICH MAN BECAME ERECT

No matter how far back we go we find that man stood erect, or nearly so. The man of Chapelle-aux-Saints was not quite so erect as the Papuan of to-day. The last stages of an evolution are taking place before our eyes. It is the evolution from the anthropoid to man, which, going from one species to another, is sufficient to prove that the connection cannot be broken.

Incessu patuit homo! The fact that he stood upright and walked with his head up permitted man to begin to assert that dominance over the world which he was later to exercise. Even though at times he had to be content with makeshift ideas, man began eagerly to scan the horizon and the star-studded heavens in an attempt to discover the secret of his relation to the universe. No other form of life questions the sky and its sun so eagerly or so authoritatively as man.

Monkeys, which now and again stand upright, and the anthropoid apes, turn by turn bipeds and quadrupeds, are examples of the first stages of that erect posture which became complete in the human race. For the very reason that it came late, the characteristic evolution of which the stooping skeleton of the man of Chapelle-aux-Saints indicates the last stages has been proved to have taken place by irrefutable anatomical evidence. A good example is the well-known weakness of the abdominal wall, resulting from the change in the posture of the human race, which is the cause of hernia and of various other collapses of the badly supported viscera. A temporary cure is achieved by assuming a horizontal position. In hospitals it is a standing joke to recommend patients to walk on all fours as a method of accomplishing a permanent cure.

The sight of two huge orang-outangs which I saw in Java playing like children on the grass with their keeper

made me think of those remote ages. First they walked about, hand in hand, erect except for a pronounced stoop and thoroughly human; then they sidled away on all fours and wrestled with each other and gamboled about playfully. I wondered to see how many aspects the two species had in common.

One wonders how the evolution, leading to the assumption of an upright posture, took place. We know very little about it. There is some evidence that there was an intermediate stage between the posture of the quadruped, with its equilibrium made more certain by the powerful leverage of the legs, and the less secure posture of the biped, which is, however, better adapted to quick movement. It is incontrovertible that the evolution began with the simian quadrupeds, continued through the anthropoid apes, and culminated in man. In the quadrumana, in which the spinal column is so shaped as to facilitate rising on the hind legs, we have the example, particularly in the forelegs, of organs primarily serving the purpose of support changing into organs intended to grasp things.¹ In the case of animals living in trees, the two phenomena necessarily occurred simultaneously.

If along with environment Lamarckian habit is the key to man's evolution, we must ascertain what organic changes took place to bring about a shifting of the posture of animal life from horizontal to vertical. Scientists have not as yet devoted sufficient study to this important problem. In all probability, the academies would not look favorably on researches along those lines. Only a short time ago, in the 'free' United States, a journalist was brought to trial in Tennessee, charged with having disseminated Darwinian theories! He even earned the distinction of being convicted. It resembled heresy treated as it used to be treated by the Inquisition, although the penalties were reduced. Even so, there seems to be scant ground for gratitude.

¹ Lamarck calls attention to the fact that the upright position of man's head permits him to use his teeth to hold things. Indeed, the facial angle has become wider, and the angle of the teeth, which is more nearly vertical, has altered.

I have called attention to the recession of the occipital cavity as being the inevitable result of the straightening up of the spinal column. The curve of the spine, which can be scientifically plotted from the pelvis to the occiput, indicates a series of compensated transitions. Such a change in the center of gravity, involving, as it does, deformations and adaptations, cannot be summarily passed over. The story of how human beings became erect might well be made the subject of a study in kinetics. The distance from crawling to flying is no greater than that which separates the baboon from civilized man. If one carefully retraces the course of evolution in an attempt to ascertain relationships, the key to the process will be found in the point of transition from one stage to the next.

The change culminating in the upright posture is not a phenomenon peculiar to the quadrumana. All we know of it is that it consisted of a number of uneven stages. Through various phases determined by habitat, the change from the quadrumana to man followed its evolutionary path. In the course of organic development every sort of experiment could be tried in more or less permanent fashion through the agency of transformation. The compositions of energy, following the line of least resistance, determined the different potentials of the related phenomena. For example, the reason that the kangaroos began to acquire an upright posture was certainly not the same as it was in the case of the monkey. Characteristic movements resulted from conditions of habit and environment. Although the quadruped's posture has the advantage of being the most stable, necessary motions require a displacement of the center of gravity, of which under favorable circumstances, the major variations inevitably tend to become permanent.

Not only will they persist in a given direction, but they will reach full development if external conditions are auspicious. What are those conditions in the case of monkeys, and what made them desirable? I cannot help thinking that the controlling factor of this evolutionary action was a phenomenon of heliotropism, caused by the arboreal habitat

and by the repetition of the gymnastic exercises inevitable under the circumstances. We cannot fail to be struck by the similarity between the heliotropism of plants, when the stem twists under the influence of the sun in such a way as to expose the flower to the light, and the heliotropism among animals, in which the quadrumana raise themselves to look at the sun.

The effect of sunlight on plants and on animals is well known. It is caused by a mechanism resulting from physico-chemical activities induced by solar action. It is quite unnecessary to go back to Darwin's admirable studies on the motility of plants to discover symptoms of heliotropism in animals. The water-tight partition which divided animals from plants because the former could move and the latter could not has entirely disappeared. In the case of certain specimens on the border between the animal and the vegetable kingdom, it was exceedingly difficult to make the proper distinction, especially as some plants were promoted to the animal class. Nothing better shows the contrast between our subjective classifications, which change with the progress of knowledge, and the actual continuity of revolutionary processes. That is why Claude Bernard used to say that plants endowed with the power to move in a given direction gave every appearance of possessing a will. Saint-Hilaire had already conceded automatic movement to both. The distinction is merely one of words; so-called will-power is automatic in nature, in so far as the phenomenon is governed by the cosmic laws which produced it.

I will go so far as to say that the formula, 'movements caused by light,' should be abandoned and replaced by the term, 'heliotropic phenomena,' since the latter implies all forms of solar energy, such as light, heat, electricity, etc. Furthermore, we must assume that it includes that power in plants which Bernard discovered, namely, that the tip of a rootlet, possessing the sensitive organs necessary to geotropism,¹ acts like an intelligent being. 'It is no exaggera-

¹ Bohn: *La Naissance de l'intelligence*.

tion to say that the tip of the rootlet, having the power to direct parts adjacent to it, acts like the brain of an animal of the lower orders. It is a fact that this organ, situated in the forward part of the body, receives the impressions felt by the sensory organs, and directs its movements.' ¹ A close analogy will be found in the movements of *Linaria cymbellaria*. Raphael Dubois says that 'its flower-bearing pedicles, during the period which precedes the fertilization of the flower, turn toward the light, but turn away from it after the flowers have been fertilized. At that time the flower-bearing pedicles twist toward any dark cavities, there to deposit their seeds in places best suited to their preservation and germination. It may thus be said that before fertilization the pedicles are positively heliotropic, and after fertilization, negatively heliotropic. Does it not seem as though these little blossoms are, like animals, endowed with foresight and with maternal love? The truth is that it is a case of heliotropic photomorphosis.' ²

Does this not, perhaps, bring us close to the origins of sensibility and of intelligence,³ and to their amazing results? Even so, it would not justify us in 'explaining' them metaphysically before having retraced their coördinations to their source. Take, for example, the transition from dermatropic vision to ocular vision.⁴ How is any one to say

¹ The effect of these irresistible automatic movements is to turn the organism toward the cause which irritates it, thus providing for a new equilibrium. In the case of light, the result is phototropism, which is positive or negative according to whether the animal goes toward or away from the light. In the case of gravity, the result is geotropism, etc. In plants, as well as in animals, the phenomenon is of a physico-chemical nature.

² Raphael Dubois: *La Vie à la lumière*.

³ The insects which are most often cited for their exceptional intelligence have, strictly speaking, no brain. This indicates a lower grade of nervous development. None the less, they perform functions of the same order as those of the *Linaria cymbellaria*, but which produce a higher order of results. It is known that bees do not respond properly, to unforeseen contingencies, yet one cannot say that they do not think. Their receptive surfaces differentiate less clearly between various forms of sensibility than do ours. The results are, nevertheless, approximately the same.

⁴ See Raphael Dubois's report on his experiments on the dermatropic retina, especially in the case of certain molluscs. *La Vie à la lumière*.

whether or not vision, due to the pressure of radiation,¹ may not be a phenomenon of touch similar to other sensorial phenomena, which are merely organic differentiations of a common state of sensibility? It is obvious how many natural connections between different phenomena are covered by the simple term heliotropism.

Before pursuing further the investigation of the origin and progressive stages of man's development from the four-legged to the upright posture, it is advisable to consider the effects thereof on his entire organism. Even if we limit ourselves to the leverage of the spinal and pelvic bone structures and their corresponding articulations for the purpose of associated movements, we should still look to comparative anatomy for an exposition of the successive stages of uprightness, from the earliest quadrumana to the man of Chapelle-aux-Saints. Even that would be only a hint as to the scope of the phenomenon as a whole. It is all a series of coördinated changes in the bone structure, together with the play of new processes at spots where muscular pull is most pronounced.

The transition from the horizontal to the vertical posture is necessarily marked in the whole organism from the occipital cavity, which was thrown backward, to the ankle-bone and to the metatarsus through the coxo-femoral articulation that the new angle of the pelvis required. All the muscles, tendons, tendon sheaths, articulations, ligaments, aponeuroses, and all the visceral organs, which had become more or less displaced, had to undergo (whether from atrophy or from hypertrophy) changes due to the requirements of new motions and to the general influence on the whole organism.

From that standpoint the question of the straightening-up process has not been scientifically considered as a whole.² It is generally accepted that those organs which support the viscera, struggling with new combinations of stresses, do

¹ Which shows the 'weight' of light.

² There is an ample and excellent reason. Such work would not receive those so-called 'rewards' which too frequently merely make life easier.

not perform their functions so efficaciously. This point I have already raised.¹ Our attention is called to the different gradations of the obliquity of the pelvic bones of the quadrumana, from the first attempt to stand erect up to the time when they became approximately horizontal, and in man acquired the shape of a true pelvis. As soon as the vertical line runs from the occipital cavity to the center of the pelvis, the straightening process is complete. These curves compensate the spinal column for the elasticity of movements which have passed from the horizontal to the perpendicular stage. It is only in present-day man (even savage) that we find the activity in the upright posture complete, since the man of Chapelle-aux-Saints was not so erect as is the Papuan of to-day.

All this evidence proves that the process of acquiring an upright posture took place; but proves it less vividly than the actual example of the infant, which, when only a few weeks old, is constantly struggling to straighten its spine until it succeeds in sitting up. This is a very significant embryological repetition of the evolutionary movement which has brought, and will continue to bring, the human being upon his two feet. Having traced the development of the mechanism which caused the straightening of the spine, we should investigate the synergies which put the mechanism in motion. Even if it be implicit in a phenomenon of heliotropism, that particular form of evolution requires, like all others, the coöperative influence of energies tending toward a similar end.

It is well recognized that the sunflower and the few other plants on which public attention has been focussed are by no means the only ones subject to heliotropism. Up to the point where it becomes geotropy, it affects the roots, leaves, and stems of all flowers. Physico-chemical activity, under solar influence, produces different results, with correspondingly different organic consequences, whether of sensibility or motility. Throughout animal species we find in new

¹ This is especially true of the uterus, which is not sufficiently well suspended in the upright posture.

forms those same phenomena of plant heliotropism which, as Bernard asserts in the case of *Linaria cymbellaria*, produce activities very similar to those of consciousness and of volition.

In the case of animals, all the phenomena of heliotropic motility are manifested in coördinations which are no longer subjects of debate. It is generally agreed that all forms of solar energy contributed to the formation of our various organs as well as to the creation of our surroundings and to the resulting adaptations. Observations made by different scientists demonstrate that light, heat, and solar electricity brought into being from the inorganic a new complexity, which we term organic life, and which they all help keep alive through the various stages of assimilation. Was not the skin of primitive animals susceptible to light to the degree necessary best to serve their ends? Does not the pigimentary stain of the infusorian indicate an individuation of effort which culminated in the eye? If one admits that, why should it cause more surprise than the theory that the sun made human beings upright? In fact, rash as such an hypothesis may seem, it is merely an unnecessary repetition of evidence, since even organic activity is strictly dependent on solar activity. When solar activity comes to an end, we shall come to an end simultaneously with it.¹

Moreover, when an evolution as characteristic as is that of the vertebral straightening of certain mammals appears, progresses, and completes itself, it is impossible that in the process supplementary energies should not have played a part. Thus, the appearance of the hand cannot have been a secondary phenomenon, since it obviously indicates the liberation of the forelegs and their adaptation to an existence at least partially upright.² The fact that man is constantly

¹ It would be far more surprising if other combinations of solar substances (as we know them from a study of the stars) had produced different planetary systems, which, in turn, had created different forms of humanity.

² I shall not linger over the evolution of the hand, the origins of which are not, indeed, sufficiently well known. It is probable that the hand developed from the amphibians, from the batrachians, and from reptiles that had inherited it from ancestors unknown to us. We know that the horse walks on the tip of the

wanting to find out, makes him raise his head so as to meet face to face the opposition of the exterior world to his inner self, and the clash between the two gives him consciousness of his human personality. Assuming the dominating erect posture was to change the equilibrium of the human organism and permit man to become an investigator. When the direction of the eye is changed, the expression is bound to change also. Thus a monkey's eye is capable of expressing wonder, of which the resigned, or rebellious eyes of other mammals is incapable. The eye of my monkey-cousin has a way at times of making me ill at ease. Perhaps it expresses surprise at the human transformation of its own image, and the equally human disappointment at its own failure to make progress.

However, once the process of attaining an upright posture began, it had to proceed, regardless of its ultimate evolutionary outcome. Since the atrophied forelegs of the kangaroo did not permit it to assume the posture of the quadruped except for short intervals, the center of gravity was necessarily thrown back. This obliged the animal to advance by leaps instead of at an even walk and forced it to sit on a tripod formed of the two ischia and the hypertrophied vertebræ of the tail.

The semi-erect posture of bears, squirrels, and of various types of monkeys presents a quite different situation. A bear, which is naturally heavy, often rises on its hind legs in order to grasp its adversary and to attack it with claws and teeth. It rises also to pull down from trees the fruits it likes. Although its weight keeps it on the ground, it is occasionally obliged, if not to live in trees, at least to climb into them when they are stout enough. The bear may illustrate the first stages of an animal rising from the ground for a specific

third toe; the first and fifth toes having disappeared, and the second and fourth having become useless. For reasons which we do not know, the hand reached its state of final development in monkeys, for man is not the only creature which has an opposed thumb which is, in fact, to be found in lemurs, which are akin to the ancestors of the monkey. It may be that living in trees was responsible for the beginning of the hand. In any event, arboreal life had a great influence on its development, and, through the constant grasping, on its final form.

purpose. The larger quadrupeds, which are firmly set on their legs, can sleep standing up. This the unstable position of a biped does not permit. I am not in a position to write a monograph on bears, but I do not hesitate to say that those species of animals which, like the coconut bear, are most often forced to climb trees to obtain food will most frequently stand on their hind legs.

In the case of the squirrel we are dealing, not with the first rough sketch of an evolution, but with an evolution perfected, at least for the moment, so far as organic conditions permit. Agility is the outstanding characteristic of the animal. Not only does the creature seem definitely to have quitted the ground, upon which it travels only by bounds, like a quadruped, but it is not even content merely to climb. It springs from branch to branch, and in some species has even developed a membrane which acts like a parachute and allows it to scale through the air like a bird. One cannot accurately call a squirrel a biped, but the straightening process caused by its life in trees and the resultant development of the hind quarters, permit it to take a sitting position while gnawing nuts.

This brings us to the numerous forms of tree monkeys, which exemplify all evolutionary stages of erectness, resulting from the Lamarckian habit of traveling through trees and of leaping from branch to branch.

I do not purpose to expatiate upon the paleontology of the quadrumana. I will merely state that life among the treetops unquestionably advanced the anthropoid to that point of erectness from which man continued and completed it. The necessity of grasping branches perfected the hand which, for greater safety, certain quadrumana supplemented with a prehensile tail. This development should not be overlooked. Indeed, it is the prehensile hand, with the evolutionary development of its agility and of the delicacy and variety of its functions, which together with the growth of the cerebral lobes, made of man that being which Henri Beer calls *homo faber* — that is, the 'workman' — instead of *homo sapiens* — a pompous and often inappropriate

ate term. In his preface to de Morgan's 'Prehistoric Humanity,' Beer does not hesitate to say: 'This book deals with the hand and its extensions.' I interpret the sentence as meaning: 'When the anthropoid attained an erect posture, its hands were released; this in course of time led evolving man to the industrial tool which, constantly undergoing improvement, was essential to the increasingly exacting demands of his daily life.'

We know practically nothing of the evolution of the ape's hand, or of the progress it made in ability to grasp things.¹ Formations resembling hands occur among some of the primitive species. It may be that the monkey was especially fortunate in the matter of evolution. A desire to walk on the earth in the guise of conqueror was probably what prompted *Pithecanthropus*² to come down out of his tree.

Any one who has watched the frenzied gymnastic exercises of monkeys in their native treetops is forced to admit that tree-life must have contributed greatly to the ultimate erectness prior to the time when the anthropoid was lured down to examine the ground. Indian monkeys enjoy nothing more than to swing upward from branch to branch until they reach the patches where the sunlight breaks through the leaves. They like to take flying leaps from one side of the road to the other. Their heads are thrown back, their arms outstretched, and, like flashes of human life that pierce the heavens, they seem intoxicated with the lure of the sky. It seems as though they were celebrating the joy of having become erect among the trees before the earth claimed them as her own.

It is not surprising that the Indian should pay monkeys a religious veneration. He owes them a debt of gratitude for

¹ Certain species of marsupials and of rodents which climb have an opposed thumb. They are erect to the same extent that bears are and frequently assume a sitting posture. This is true of marmots and of prairie dogs, which, however, do not climb. A dog will sit up to beg. A dog can learn to walk on its hind legs. A duck is still horizontal, but its neck indicates a tendency to erectness. The species of duck known as the Indian runner truly stands up, and the penguin actually is erect.

² *Pithecanthropus erectus*.

the help which their magician-prince, Hanuman, once gave to Brahma in his battle against the Titanic divinities, as told in the earliest cosmogonies. Although the unbelieving European is excluded from the temple of Kali, near Benares, monkeys are allowed free access to the sanctuary. Along the cornices of the palaces that overlook the Ganges, the eye of a monkey, half hidden in the tangle of a white and venerable beard and softened by a superhuman philosophy, looks down in dreamy immobility upon our earthly agitations, on which in vague scorn it declines to pass judgment. Every gesture of our predecessor is the counterpart of our own actions. In the land of Ramayana the quasi-humanity of the ape is accorded a deeper respect than is paid to man, in spite of the higher stage of evolution which man has reached. Since we have attained to a degree of intelligence which permits us to see the world objectively, should we not take pride in the ascent from those remote origins and ancestors which we have been privileged to achieve?

From that point of view, organic interrelation seems to require that man undergo a process of mental straightening, which is the complementary manifestation of the physical erectness. Thus, when we progress from atavistic ignorance to scientifically coördinated knowledge, it is a phase of that same human straightening that goes on to bring the resonances of our understanding into harmony with those of the Cosmos. In this development of an increasingly erect consciousness, man can be but an ephemeral incident. On the other hand, what more glorious fate could be ours, than when, inspired by the vast conflagration of blazing space, the human mind, tethered to its extinct planet, rises up before the world in which it is but a passing spark, to seek the measure of the immeasurable, and, at least for the moment, is not to be denied! What greater achievement than to extract the nuggets of relative truth from the solid and unyielding mass of the incomprehensible absolute!

It was for the purpose of accomplishing this incomparable task that the mysterious anthropoid climbed down from his

tree. From the moment he set foot upon the ground and walked about waiting for the day when he was to make the sea and the sky his very own, an evolution began, compared with which all others are mere preliminaries. Man's body is four-square. His eyes look to the stars. His thoughts drink deep of the blue immensity, which is the ærial cloud veiling inaccessible infinity. To ascend his throne, the temporary lord of the world had merely to stand erect. Contrary to the tenets of feudalism, his ancestors count for nothing; his nobility is in him and in his descendants. It may well be that at some future day he will hear himself censured for having been dilatory in exercising his privileges. He thought himself a slave. His credentials, which he misread, proclaim him overlord.

To be sure, such an exalted patent of nobility at first frightened him. When it came time for him to exercise his will, he was still feeling himself over in search of his shackles. He believed himself a slave; such was the first step in his destiny. By right of evolution he is overlord, and that will be the glory of his lot in the ages that the future will accord him. To-day, he is still vacillating between the *imperium* of his present life and the dull apathy of the past; he is wondering whether there may not be some way of harmonizing the pompous allurements of ignorance with the continued effort required by the exercise of his will power. Between the two he has no choice. This erect posture, from which he cannot escape, imposes upon him the obligation of doing and of knowing, because of what he sees on all sides. Throughout the stages of his life on the ground he felt his importance before he realized that he was the master. Man was ever eager to learn about the world, about himself, and about the sky; to accomplish this he lacked only the courage to attack the problem.

MAN SPEAKS

In the earliest remains of man we find the key to human evolution. When, in the days during which Cuvier was supreme, Boucher de Perthes happened to discover in the

alluvial deposits along the Somme some implements of hewn flint and stones polished by the hand of man, he caused nothing less than a revolution. Similar specimens had already been discovered, but they had been called 'thunder stones,' for it seemed more plausible to regard them as the handiwork of God than as that of common humanity. In the same deposits bones of the mammoth, of the great lion, of the rhinoceros, and of the hippopotamus were also unearthed. Thereupon broke out a controversy which became epic. De Perthes was bombarded with academic anathemas; but, after his death, he remained the victor.¹ He had laid the foundations of the study of the prehistoric ages.

From all parts of the world, and especially from the depths of Asia, confirmation appeared. Science was collecting its data. The days of polemical ignorance had passed. We had freed ourselves from the grasp of the quicksands of Biblical Genesis, and had won the right to know ourselves. Ours to make use of that right.

¹ It is most interesting to read of the battle between Boucher de Perthes and the Académie des Sciences, headed by Georges Cuvier, in which the former tried to force an examination *in loco* of those authentic specimens which proved the tremendous antiquity of man. To-day, we speak in terms of millions of years. At that time the argument was over a matter of 'five or six thousand years.' Cuvier himself said so, and, by stating with absolute finality: 'There is no such thing as a remnant of fossil man,' he effectively barred the road to further investigation.

After Boucher de Perthes died his family had his works destroyed. Under the supreme command of Élie de Beaumont, permanent Secretary of the Académie des Sciences, a bitter campaign was inaugurated to prohibit the promulgation of the theory that there was such a thing as fossil man. A Catholic scientific magazine (*Les Mondes*) even went to the length of questioning de Perthes's good faith. This situation lasted for more than fifteen years. Then from the strata of the quaternary age rose up dead men to confound the living. Victor Meunier tells the whole story in a little book, *Les Ancêtres d'Adam*, of which the first edition was summarily suppressed. One copy, which was saved from the destruction, made a second edition possible. It is an interesting example of the sort of obstacles of mixed science and ignorance which even in our own day had to be overcome by disinterested efforts at learning. Cuvier was a gifted scholar who created the sciences of paleontology and comparative anatomy and, if he claimed an autocratic monopoly of knowledge, what may we expect of the ill-educated masses before whom institutions of learning pompously pose as being the sole disseminators of truth?

It is unnecessary for me to describe in detail the earliest implements of primitive man. The Museum of Saint-Germain and various private collections contain many interesting specimens. I will merely say that these primitive implements have been found in great numbers in all countries, and that the most surprising thing is their almost universal similarity. When one stops to consider, the fact is by no means surprising, since the same requirements produced everywhere the same reactions in the same organisms. The only difference was in the materials employed. It appears that the first stage of rudimentary civilization was very nearly uniform. The transition from the savage to the artisan must have occurred at some period of the age of worked stone. Later came the use of metals, which indicates the use of fire.

Necessarily the life of man in those ages was animal, that is, instinctive rather than the result of thought. Aided by favorable climatic conditions, certain races better endowed than the others with powers of resistance precariously survived. What tremendous stretches of time elapsed during which man's crude mentality fumbled about, trusting to chance for the accidentally won necessities of life! Existence had but one purpose: to escape from the strong and to attack the weak. Such had been the life of the pithecanthropes. Before man knew the uses of fire, his weapons were primitive implements which he supplemented with instinctive cunning in his struggle against the savagery of his antagonists. Evolution groped its way through the confusion and was motivated by the compelling need of self-preservation at any cost.¹

¹ Divergent evolutionary tendencies are particularly noticeable in monkeys. The chimpanzee seems to be on the threshold of human intelligence. The orang-outang is so humble and so gentle that he seems to have submitted to the dominance of things, whereas in man it was the desire to penetrate and understand this tyranny which aroused the deepest emotions. The gorilla, with its huge frame and cruel teeth, seems to be a conquering monster gone wrong. Pithecanthropus, of herculean proportions, descendant of unknown but common ancestors and inheriting all these and many more potential characteristics, appears to be the vestige of an organic power which, in its evolution, will dominate everything. To pass at one leap from the Javanese remnants to the skull of

It was probably the family, and later the tribe, banding together to resist attack from without, which saved man from destruction. There must have been times in which the existence of the race was in grave danger. It is, indeed, remarkable that certain peoples, least fitted to invent ingenious devices of attack or defense, such as the negroes, should have increased greatly in countries where lions abounded. Fire was an important method of protection. However, the worst days were past. Very early, animals came in different ways to recognize man as their master. It was the lot of civilization to make its precarious way between the axe of flint and the jaws of wild beasts. Man's ancestor had come down from his tree, and, except occasionally, man could not climb up again.

The element of the unforeseen prevented any continuity of plan or any sequence of purpose. Thus ages passed which we cannot appraise, and which, in fact, we can only vaguely imagine. The club, which later developed into the scepter, and which the anthropoid of to-day still values so highly, and whatever missile fell under man's hand, were the earliest means of attack or of defense. It seemed to me that a small Calcuttan monkey which cracked nuts between two stones showed aptitudes which reveal a very considerable development. Undoubtedly he learned from man to get the stone which served as a hammer, but is it nothing that he did learn? At Amsterdam I noticed a monkey cracking nuts by throwing them between its legs against the iron floor of its cage. One wonders whether initiative or imitation played the greater part in his feat. An examination of chipped or polished stone implements forces us to admit that our earliest ancestors unquestionably had marked powers of invention.

It is impossible to know certainly whether the discovery of fire preceded or succeeded those crude implements, copied, perhaps, from eoliths¹ which had been previously used for the man of Chapelle-aux-Saints and of the Neanderthal man is spanning an enormous gap. Nevertheless, it is perhaps less wide than the gap between the man of Chapelle-aux-Saints and the man of to-day.

¹ I have already stated that 'eolith' is the name given to stones which were split and subsequently worn smooth by the action of sea-waves until they often resemble the handicraft of a workman.

similar purposes. The history of various subdivisions of the human race might well inspire in us the feelings of modesty and of humility which we very often lack. The simple co-ordination of means of offense or defense which has been handed down through the animal series indicates an undeniable sequence of continuous methods of satisfying the needs of primitive man. Time had to elapse before it was possible to differentiate between the habits and customs of various anthropoids and those of the earliest men. Even to-day there are too many similarities not to suggest common primary impulses.

Does not the endless succession of insensible transitions make it clear that we can no more define the last anthropoid than we can define the first human being? This is due to the lack of those characteristics which are necessary to subjective classifications, and which develop only in long periods of time. Imaginative 'revelation' loves theatricalities. From force of habit we continue to subdivide universal evolution into subjective compartments, whereas, for a correct understanding of the world, we must recognize an unbroken continuity, which proves that universal world-activity is but a single phenomenon of infinity. It is a phenomenon of phenomena that cannot be segregated.

The earliest men, still bound by the habits of their animal ancestors, continued their struggle to obtain food. They were satisfied with whatever they found; they hunted, fished, and killed with crude equipment.¹ As time went on, their implements consisted successively of chipped flint, of polished stone, and of bones, cut, pierced, and carved. These we find buried under piles of ashes, and, by their better adaptation to their purposes they indicate increased skill as well as the fact that men gathered about the

¹ We inherited from primordial beasts the unfortunate tradition of killing, which has evolved into the brutalities of the slaughter-house. The so-called progress of war machinery, which has greatly surpassed the development of all other machinery, has to an appalling degree increased the shedding of human blood. After all, if both are weighed in the balance, cannibalism has the excuse of hunger, which is more than can be said for the useless slaughter of war.

family hearth, which was the first *situs* of incipient civilization.¹

The charred embers and the bones, human and animal, which we find in caves and at the foot of the cliffs against which primitive men built their huts made of branches are the remnants of their meals. In later deposits we find the bones of domestic animals, which do not differ radically from those of to-day. Men made weapons, especially bows and arrows and spears. They carved reindeer antlers and mammoth ivory as well as wood and the horns of various animals. In course of time they learned to harden their pottery, at first unbaked, in primitive ovens. Skins were found useful as protection against the rigors of climate.² Ropes and the remains of boats have been discovered in lakes. Early artistic efforts give us a none too flattering idea of the women of those ages.³ From a few graves we obtained fossil remnants of man which differed so greatly from the bones of men of to-day that they later raised serious questions about ourselves and about our more immediate ancestors.

The huge animals of those days, pursued by man and unsuited to climatic changes, gradually became extinct. Nomad peoples learned how to supply themselves with food in one spot, and thus in certain instances became settled, and changed from wandering hunters and fishermen

¹ The Museum of Saint-Germain contains an infinite variety of instruments intended for all sorts of purposes, which before the discovery of metals the ingenuity of primitive man was able to fashion from stone. Man's ability to use metals marks a decisive point in his history, and gave him that mastery over the elements on which we to-day pride ourselves. The use of metals was the result of the discovery of fire.

² The fig-leaf of Biblical fame is an indication that long before clothes were used for utilitarian purposes man became aware of certain feelings of modesty.

³ The art of the paleolithic age died with the age. However, the lines of various stone implements evince a happy sense of proportion — a merit by no means small. Some of the stone axes, both as to material and beauty of proportions, are true works of art. Ceramics were not unknown. It is said that the men of the paleolithic age were hunters and fishermen, whereas those of the neolithic age were agriculturists. Of course, the two ages overlapped. To what extent, no one can tell. The next period was, perhaps, that of the dolmens, menhirs, and cromlechs, which brings us to the threshold of that stage of evolution which we term 'civilization.'

to shepherds and farmers. Fire was discovered, which permitted the use of metal, with the result that man's tools improved greatly. Lake settlements sprang up. Man showed unlooked-for artistic feeling in his choice of materials and of form. Thus, we can follow the successive stages of the prehistoric cycle. We wonder, however, what may have been man's methods and means of action. It hardly seems possible that the workman and the artist should have made such progress without the help, not merely of language, but of a fairly well-developed language. No one would care to support such an hypothesis.

It is true that certain animals do remarkable things, even without having a brain. But, except for 'prentice experiments, they can only repeat the act mechanically, and, outside the scope of their habitual activities, show no sign of having any diversity of resource. Obviously, man's situation is quite different. In the first place, the complexities of our gregarious lives constantly require complex relations, in order that the associated organisms may survive. In the second place, language is essential to the transmission and to the application of the traditions and working rules necessary to the manufacture and use of implements, to the tillage of the soil, to the maintenance of the domestic hearth, to the methods of hunting and fishing, to the art of using wood and stone, to carving, painting, and sculpture. For this reason we must first fix our attention on the matter of language and speech.

I am trying as far as possible to state in brief form the little we know of human beginnings.¹ Scientifically to correlate the documents which we have begun to collect, in order to extract therefrom a coördinated history of the earliest manifestations of human life is a task in many ways beyond

¹ I cannot be expected to enter upon the multiple origins of humanity. 'Holy Scripture' carefully avoided 'revealing' anything of this matter. The experimental aspect of the question remains unchanged, regardless of the number of origins and of the conditions which evoked them. Sooner or later the problem will be solved, but in the meantime all the evidence tends to prove that on various continents (some of which have disappeared into the sea), different climatic conditions produced different results.

our present powers. The ground which, to date, has been ploughed is insignificant in comparison with what remains unbroken.

Indeed, only what might be termed a 'miracle' saved from complete decomposition the bone remains of Trinil in Java, of Neanderthal, of Chapelle-aux-Saints, of Piltdown, of Cro-Magnon. But, since the 'miracle' happened and at points at which it was our good fortune to discover it, why should we be forbidden to make further use of it in an attempt to lay the foundations of a knowledge which must inevitably increase? For thousands upon thousands of years we have gone our ways without asking the earth to yield us her secrets and without investigating that huge receptacle of planetary phenomena from which we ourselves have sprung. Our decisive discoveries were made only yesterday. Undertakings of every sort are beginning to scratch the surface of the ground. Universal curiosity has become aroused, whereas the supporters of dogma have been alert for centuries. If we think ourselves satiated with surprises, what will be the frame of mind of our descendants?

We can at least say to-day that from the sum total of our observations we have obtained a conception of man and of the world very different from that which primitive ignorance for a long time willingly accepted. The statements of 'Revelation' have the undoubted advantage of being absolute; their great drawback is that they are not susceptible of scientific proof. Must we prostrate ourselves before the unknown without making any effort to fathom even parts of it? It has never been possible to ask the question in a doctrinal manner, for, from the moment when man's investigations brought him to the point of scientific verification, neither fire nor sword could deter him in his pursuit of knowledge. Thus it is that in the face of the bitterest opposition we are to-day occupied with the task of reconstructing the real ancestors of thinking humanity with whom by straight descent we find that we are connected by stages of evolution established beyond any possibility of question.

Bones, tools, even works of art, tell a story of the world very different from Bossuet's version. With cautious diplomacy, persons of great and mediocre intelligence vacillate between the two views. The inescapable fact of evolution forces us on and we cannot turn back.

At some future day we may be able to reconstruct the genealogy of various pithecanthropes, who through countless ages paved the way for humanity as we know it. That will immeasurably increase the scope of our knowledge, but even now we can emphatically state that it will in no wise modify our scientific point of view. From certain bones, which determine the character of others, we have reconstructed skeletons, and the skeleton determines the organs. Through the mist of ages we can dimly see passing before us the men of Cro-Magnon, of Chapelle-aux-Saints, of Neanderthal, together with their Javanese ancestor, marching to their destinies. They lived at the expense of their neighbors, for such was the universal law of which they were the product. And, according to the law of their own cycle, they, the rising children of humble parents, reached a stage determined by evolution that enabled them to bequeath to their posterity indescribable possibilities of greatness.

At this point language became the most important factor in the development of their growing organic mentality. Reactions of sensibility, together with the resulting associations and dissociations, created in the various groups of animal life states of subconsciousness, and even of actual consciousness, out of which the ganglionic, or cerebral, accumulator made states of so-called mentality. In the case of man, superlatively gregarious by nature, the refinements of sensations mnemotechnically recorded would be useless without the emotional ability to communicate them, that is, without the exchanges preparatory to interaction. The evolution of individual and social thought can go on only through incessantly multiplying the means of intelligent control throughout the whole field of reciprocity. First and always that is what is required if we are fully and freely to be able to reach common understandings, for attaining

which language with its niceties of expression is the indispensable means.

I shall not go into the history of language. When one has entered even superficially upon the intricacies of the various languages with which etymology concerns itself, and when one has realized the gradations of distinctions which evidence the refinements of analysis in the subtle adaptation of sign to idea, one stands bewildered before the refinements of thought to which after many centuries, human ingenuity, under the spur of necessity, has been able to attain. I am by no means certain that grammar is not the masterpiece of human intelligence. Our teachers make a great mistake in expecting us to understand it before we have reached the age of fifty.

Languages, with the grammar implicit in them, are the work — sometimes conscious, sometimes unconscious — not so much of special artists, as in the case of music, as of whole peoples. These peoples felt the irresistible need of expressing their love, hatred, rebellions, complaints, wishes, hopes, and desires, just as many animals, unassisted by language, have unsuccessfully tried to express their agreeable or painful emotions. Comparative grammar will some day be of inestimable value as a guide through the intricate maze of expressive sounds. At present, we have only begun the task.

Important linguistic work has been done in this complicated field, and already considerable light has been thrown upon the phenomena of the life of languages. I am not running a bureau of general information, and at the moment I am chiefly concerned with the original formation of language in the series of evolving organisms. As yet, I have only progressed as far as the exceptionally difficult problem of the origin of articulate speech, which is the outstanding characteristic of the human race. I shall content myself, then, here as elsewhere, with a few summary remarks concerning those positively established facts which have been gathered from a study of the earliest stages of evolution now known to us.

In one way or another animals of all sorts make use of

vocal sounds to express their feelings. These expressions are more or less clear according to circumstances. Insects buzz and make noises with their wings. Mammals have at their command a great variety of vocal sounds and therefore pay more attention to the inflection than to the mere act of producing a sound. Birds sing.¹ Fishes in their deep wisdom, remain silent, and so in fact do the majority of living organisms. Just where evidences of expressive sound begin in the living scale is a matter of future study. So far as we can see, bees and ants like many species of birds, assemble without any perceptible summons. I have called attention to the parliaments of swallows. These manifestations are of great value to the individual as well as to the social organization. Although we cannot always appreciate their meaning, we cannot deny that they provide supplementary methods of communication between living beings and the Cosmos, which greatly facilitate and increase the number of the relationships of life. Hence perfecting vocal sounds may have an important bearing on the scope of future evolutionary development. Grammatical refinements of speech constitute an invaluable attribute which only man enjoys.

Any one familiar with the modern methods of linguistic study may reasonably hope that at some future day we shall discover the origins of the correspondence between vocal signs and the articulations of thought. Whoever knows the meritorious work of modern linguistics will not be discouraged. In the earliest languages grammar was practically non-existent and was restricted to what was needed to show the simplest relationships. As soon as man knows, or thinks he knows, something, he wants to know more. This requires an increased flexibility of thought and of speech which ultimately will develop.

Thus developed these habitual practices (Lamarckian habit) the correlations of which formed the main outlines of grammar, which constantly became more complete and ef-

¹ How generally is it known that mice sing? I have seen them and heard them sing both in Vendée and in America. Their song was like that of birds. The fact is established beyond argument.

ficacious. The arrangement of words, skill in giving them cohesion, and sundry inflections, were bound to unite in forming a man-made organism, which was wonderfully modeled on a sensory organism and which expressed feelings in an increasingly intricate and delicate manner. By having recourse to all sorts of associations and dissociations, supplemented by metaphor, words produced those refinements of thought which animistic metaphysics could explain only by their *deus ex machina*, the 'soul,' which is the coupling-pin of all entitative miracles. In course of time writing stabilized these articulated sounds by giving them concrete form, which was the receptacle of the idea involved. Words were materialized, personified, to the point of acquiring sex, and no one felt the absurdity.

In course of time Lamarckian habit made it increasingly difficult to distinguish between the idea and the expression thereof, until speaking seemed to be the equivalent of thinking. Yet swallows make ready for their migrations and discuss their journey without articulating a single word, whereas men who are by no means savages often repeat words of which they do not know the meaning, believing that when they talk they think. Of this Rabelais's torrential babble is an excellent example. Is it possible for speech to precede thought? Apparently not. On the other hand, speech may give the shape to an idea which often determines its substance. If the thought of animals is disconnected, it is primarily from lack of articulate speech to sustain it.

Did *Pithecanthropus* talk? Were there, on the border line between beast and man, ape-men who tried to utter incipient words? No one knows. We do not even know whether the Neanderthal or the Chapelle-aux-Saints men were capable of articulate speech, or could merely make sounds. A long sequence of semi-articulate men probably showed a rising scale of differentiations through which we could hardly find our way. If the need makes the organ, the need of drawing distinctions between sounds representing distinctions of thought must have caused the evolution of the organs of speech.

Articulate speech then evolved as a result of the need to define new forms of thought and of feeling. Therefore, I cannot go so far as to assert that in its present form speech preceded thought. Nevertheless, it is sensation that, seeking more accurate communication, unquestionably created the need to articulate. Again, it is a long step from vocal articulation to words which reproduce an idea. I can only explain the transition from animal sounds to the first manifestation of human mentality on the theory that some one articulate word developed in a group of anthropoids or of men antedating our Javanese ancestor, or even the man of Chapelle-aux-Saints. Without prejudice to the mental abilities of partially developed men, I call attention to that evolution which bestowed on them the wonderful implement of thought. This leads me to catalogue this new stage of evolution under the heading announcing a new world: 'Man speaks.' That is to say that men expressed sensations of which the associations and dissociations of language made thought.

I will merely add that, although we have no actual history of the formation of spoken language, we have early chronicles of written language in the form of ideograms, which rapidly developed into the alphabetical symbols that form the final stage of articulation.

MAN THINKS

Man felt. Man reacted by emitting vocables fit to express those relations between things which are the stuff of thought. One may then say that man had acquired the power to speak and to think. *Homo sapiens* began to take form.

Little as we know of man of the quaternary age, we cannot deny him the distinction of having been the first to begin to show the characteristic manifestations of thought. The men of those days lived a generally animal life, from the demands of which no organism can escape, but along with it went a developing mentality which brought to evolved organisms the nascent guidance of sensibility.

They were hungry; they were cold; they were afraid of things and of themselves; they feared what they saw and also what they did not see. Their outstanding characteristic was a budding understanding which required countless ages to bring about a coördination between feeling and thought, the results of which we see to-day.

That these earliest men, dazzled by the adventure of living, could attribute life only to a 'miracle,' is merely their avowal, which has a touch of naïve vanity, that they were unable to explain the phenomenon in positive terms. Was it not inevitable that their first steps should be in a wrong direction? Could the first investigator understand that he knew nothing of himself or of the world, and thus find himself forced to give up all further search? To be wrong is immaterial in comparison with a renouncement of all effort to know, implying, as it does, the abdication of our personality, which, by a process of inverse evolution, would bring us back to the state of animals. Rather than that, it is better to batter one's head against the 'miracle,' better to build for one's self a Cosmos of hallucinations and of entities, and to install therein a divine phantom of ourselves. The shocks we feel when our mistakes are confronted with scientific facts will, after a series of inevitable consequences, bring us back to the relativity of human knowledge, that is, to the task of building up a knowledge based on our senses. If it were not for the original blunders of our ignorance, there would be to-day no such thing as 'truth.'

Thus, the great struggle between thinking man and his personification of the absolute, was initiated. You will find the outcome of that struggle if you will compare the Genesis of the Bible with the cosmogony of Laplace. There can no longer be any question of the continuous progress of human experience or of the continuous regression of the Divinity.

If the theory that the human race sprang from a divine source obliges us to repudiate the scientific facts which our intelligence has discovered in its efforts to understand the world, what alternative is there other than to give up the flattering belief in our supernatural origin and to accept our-

selves as we really are? The truth is that we are a planetary phenomenon in process of evolution. Even that is more soothing to our vanity than is the ignominy of that slavery in which God started us.

To trace our line of descent back to a Divinity, it is necessary to break the sequence of phenomena, and that sequence is the unchangeable law of the universe. If we are slaves of a necessity from which nothing can rescue us, the animal origin which organic evolution requires and the filiation of species of which it is the consequence must be accepted by those who in the beginning most stubbornly denied them. Either everything is connected in an unbreakable sequence, or everything goes along haphazard, according to divine whims. We must choose between the alternatives. Even against the weight of conclusive evidence, dogma is necessarily obliged to combat the theory of evolution just as obstinately and blindly as in days gone by it contested the theory that the world revolved. Why linger over such unworthy objections? Our task is to retrace the line of descent as far back as scientific research will permit.

I have called attention to the dawning light which fossil bones have cast on the problem. The variety of specimens on exhibition in museums incontestably proves a very long line of descent, and so confirms the brilliant theories of Lamarck and, subsequently, of Darwin. Even if our earliest type of man is a pithecanthrope, many breaks in the sequence will have to be filled. For our problem here is the especially elusive cerebral evolution from the anthropoid to present-day man. The relatively few fossil skulls which we possess, even with the help of all available fragments, can at best indicate only a series of stages, the sequence of which is but vaguely suggested. In spite of the many difficulties of the task, we have established enough links in the chain to enable us to reconstruct, at least in part, sufficient stages of the mental progress of man to allow us to draw certain legitimate conclusions.

‘What may have been the religion of the ‘first man’? Such a phrasing of the problem is too superficial, especially

when expressed in terms which permit no solution. Where was the 'first man'? Who has spoken with him? Who has been able to reconstruct the constituent elements of his mentality? What evidence is there that he had a particular 'religion'? How is one to determine in the series running from the anthropoid to man the various transitions from a growing simian mentality to the first evidence of human intelligence? To expect, as do the clergy, that a complete solution of these problems should be immediately forthcoming, without any progressive experimental or scientific proof, is obviously beyond the realm of human possibility.

Is it reasonable to expect that in the animal sequence, which runs from the remotest ancestors of *Pithecanthropus* to Lamarck himself, certain highly characteristic stages of the evolution of phenomena should not escape us? In the course of the evolution of the sensations of the *pithecanthropes* and of the reactions of human thought developed in the long line of their posterity, how can we pick out the particular individual in whom the magical realization of the humanized anthropoid was made? The best we can hope to do is to follow the evolution of mental development which atavistic and primitive minds have dimly indicated.

The first men, like the last anthropoids, sought in an animal way to relieve their sufferings. What efforts they made! What disappointments they encountered! Monkeys, it appears, are one of the most delicate species of mammals; they cannot stand a change of climate. The anthropoids seem to be no better equipped, and even man is so defenseless against the vicissitudes of life that it is surprising that he should have survived up to the time when his increased mentality enabled him to protect himself efficiently. In all probability, he was not in the least concerned to create a religion, monotheistic or otherwise. In those days, man was still too closely akin to the beasts.

The first step was taken when, under conditions of which we are ignorant, man felt the first elemental urge to pray. Whether he addressed his prayers to no matter who or what, be it a stone, a tree, an animal or even another human being,

is wholly immaterial. The fact remains that he had to kill in order to live, and that at times he was even obliged to feed upon the flesh of his neighbor. He had to clothe himself, to find shelter, and to keep warm. If one is prepared to admit that anything resembling a dramatic climax occurred, it was probably the discovery of fire. To us fire is so all-important, and its uses have been so highly developed, that we dare not contemplate the time when our supply of fuel may become exhausted.

Simultaneously with a remarkable progress in methods of sustaining life, the hearth fire developed. The latter caused the drawing together of groups in families and in tribes, which facilitated defensive measures against the attacks of animals as well as against the rigors of the elements. It brought about a complete revolution in the life of the individual and of the community. The marvel of terrestrial fire tends to fix man's eyes on the ground, but, alas, as he lifts them to the dazzling sun, his thoughts fly into the realms of the myths which in those days supplied the only form which a necessary, but premature, instinct of worship could assume. Religion and knowledge were children of the same parent. It was man's insistent desire to understand the world by constantly looking upward at the sun which turned him into an erect being.

Is it proper to say that fire-worship, like the even earlier sun-worship, was man's first religious cult? In any case, it seems to have been the first of the great generalized religions. Yet the fetishes of caves wherein fire, which was already known, played no part, and in which we have so far discovered only one or two symbols of the sun or of the moon, evidence the existence of myths and rites dating from the days when man's ancestors, their gaze still fixed on the earth, were perhaps no more concerned with the stars than were the last of the anthropoids. The truth is that we can no more identify the first religion than we can identify the first man. People familiar with the vast number of more or less perceptible evolutionary stages which produced present-day humanity will find nothing startling in this statement.

If one admits that from our standpoint the discovery of fire was the miracle of miracles, it is quite possible that this same discovery spread so fast and in so many ways (including spontaneous combustion and the resulting forest fires) that in the beginning man had neither the time nor the means to base any doctrine on his wonder. Children evince more surprise at some toy than they do at an automobile or at a telephone, instruments which to them are everyday matters. Who can say at what precise moment in his life some particular thing surprised him — whether it were fire, or the sun, or any other phenomenon? Hereditary habits were automatically and gradually transmitted until they became consolidated in man, the last-born of all living creatures.

In spite of this fact, our verbal classifications of knowledge have had a tendency to segregate phenomena which are really inseparable. Each interdependent link in the chain seems to be isolated and endowed with an existence peculiarly its own. This is especially well brought out in the well-known controversy concerning the origin of species, each one of which, according to Cuvier, who was ignorant of the law of evolution, resulted from a special creation.

Why should people argue as to whether man of the quaternary age was, at least temporarily, monotheistic? We have not even a shred of evidence bearing on the subject other than the modern declaration of the 'rights of God,' of which the most miraculous part is that it is man who feels obliged to defend them, and not the Almighty who had most at stake. We can discern no more indications of religious feeling in the anthropoid in process of becoming human than we can in his forbears. What resource other than falling back on imagination was there for men who had reached a state of mental development which impelled them to investigate the world, but who were ignorant of all scientific methods?

That is why I do not hesitate to maintain that the first religious impulse of primitive man marks the transition from the anthropoid to *homo erectus*. Do I not pay a signal

tribute to the divine hypothesis when I say that therein is to be found the first specific characteristic of the man becoming aware of himself and of the world which holds him prisoner? It is the decisive stage, the universal criterion by which to detect the animal who has taken the step from animal to man, and who will later develop a mind. *Homo religiosus* preceded *homo sapiens*. Only, we must constantly keep in mind that there is no first man any more than there is a last erect pithecanthrope, because such classifications as we may make to-day are not sufficiently definite to establish our terms. It has required much time to hit upon fit names to designate the dividing lines among inseparable phenomena.

What complicates these distinctions even more is that *homo religiosus*, who is a transient product of human intellect, survived for a very, very long time after *homo sapiens* had materialized. The reason is plain. The impress of primitive ages on organs still in the flower of their sensibility was too profound, the heredity against which nothing came to warn us was too powerful, the experimental reaction of later generations requiring great labor was too slow in its advance. That was the most serious obstacle in the path of man, struggling with himself, progressing with difficulty from the darkness of animal ignorance to the glimmering light of science, which unfortunately too often led him up blind alleys.

A divine Revelation could have settled the matter once for all, but, failing that, is it not easy to understand that the 'earliest primitives,' occupied as they were in protecting themselves against hunger, cold, wild beasts, and other men, should inevitably have endowed the world with what they found in themselves — namely, an activity resulting from personal volitions reacting to the elements? Does not a child hit the table against which it has bumped itself because it is convinced that the table intended to hurt it? Were not the earliest gods the products of just such mental attitudes? 'Design' and 'intention' took the place of law in the activities of the elements. Stones, trees, beasts, the sky,

the earth, and the water were considered to have wills of their own. Hence, it became a question of reasoning with them, of conciliating them, of being ready to offer them homage, sacrifice, and service in 'logically' conceived rites, and, above all, of not withholding gratitude, even if nothing had been granted in return for abject prayer. 'Magic' is the basis of all cults on the theory, as I have already said, that properly conducted rites should, and in fact must, actually direct divine activities.

To emphasize the point, graves, perhaps of a later period, indicate a belief that life goes on after death. They contain clay figurines, bas-reliefs, idols, statues of women (by no means flattering), bowmen, animals, reindeer, wild boars, and especially bison, and in fact all manner of things. In a low-studded cave which I have already mentioned have been found in the clay the imprints left by men squatting on their heels. The group may have been assembled in council or to perform some religious ceremony. In India I have seen people wearing animal masks and even the whole heads of beasts in their sacred dances. There are many symbols, of which it is difficult, and often impossible, to understand the significance. There too, as everywhere else, was found the equilateral cross, already mentioned. There were arrows, arranged with some particular significance, or perhaps merely as chance dictated. There were hands, which are the emblem of power, and which are to be found in Jewish and Christian symbolism, and, going back through the ages, even on an Assyrian obelisk and on a Chaldean cylinder. They reappear in Indian carvings and in Carthaginian *ex-votos* and even in our 'hand of Justice,' which proves the longevity of a symbol still revered by the Australian savages. Finally there was the wheel, emblem of the sun — a ring bristling with rays — which is notable because of its rarity, for, if it occupies only a secondary position in paleolithic life, it indicates, nevertheless, in what very early times it first appeared.

I have thought it wise to conclude my argument with this summary enumeration of developments which are very

closely linked in the progressive manifestations of humanity. There is not a single phase of human development which does not prompt us to retrace it scientifically to its origins. We must choose between the sacred legends, not one of which can withstand the test of investigation, and the scientific doctrine of evolution, which Lamarck first propounded, and for which Darwin supplied the experimental documentation.

All that the Church can do is to cling to a dogma which it will not allow to be discussed. So far, theology has permitted nothing affected with a taint of science to align itself under its banners. The cautious Abbé Mainage did not care to go farther than to say that he does not admit the theory of evolution. It is most unfortunate that he does not see fit to inform us just how the cave-dwellings of the quaternary age, which he does admit, can be made to agree with his Biblical explanation of the creation of the world. Silence is a blessed refuge for perplexed souls!

What reasonable explanation can be offered to account for the fact that God, supposed to be absolute perfection, should have absurdly taken the trouble to create something imperfect, only to impose on us, poor mortals, the task of perfecting it, and then should have punished us with eternal damnation for not succeeding where he had failed! If for some inconceivable reason (after the lapse of an eternity which contained no terrestrial creation) the 'Creator' took it into his head to produce something 'new,' — which is incompatible with his supposedly fixed and immutable nature, — why did he not give himself the satisfaction of doing a perfect job at the start instead of creating man 'in his own image' — a creature so imperfect that he first appeared in the shape of the man of Chapelle-aux-Saints, who was about halfway between the anthropoid and the present-day civilized human being. What could have been the idea of creating an ignorant savage unsupplied with any means of protecting himself against the hostile elements, and of then burdening him with appalling tasks, only to abandon the world to the uncertainties, to the sufferings, and to the disasters of

all future time? Whether or not the Abbé Mainage admits the theory of evolution, he cannot deny that man has undergone great changes since the quaternary age. What is the law which underlies these changes? Let him explain why his God decreed and effected the close interrelation of so many failures.

For man to have 'changed' since the quaternary age, he must have undergone, as all other phenomena have undergone, a series of 'changes.' About these changes 'Revelation' is silent, and not without cause! Long periods of vacillating thought have shown us developments of forces in forms termed 'evolutionary.' What other law than that of successive relationships does 'Revelation' suggest? Until it shows itself capable of some such effort, the two things must continue to be considered contradictory. Nevertheless, growing knowledge progresses irresistibly, and dogma remains silent when asked to produce its evidence. Its silence is an admission of its inability to do so — no more, no less.

To inveigh against us because we do not know the details of every cosmic stage is a form of puerility too easily understood in people who naïvely confuse what they know with what they say, and who believe that they possess the ultimate secret of things — simply because they choose to credit themselves with such knowledge. It is only too true that our knowledge of phenomena is far from complete; in fact, such knowledge as we have does no more than show shifting relationships. Of those relationships we grasp only infinitesimal fractions. Observation, however, supplies us with various starting points which, by experiment, calculation, and induction, we do our best to coördinate according to their natural tendencies. We make mistakes, and we more or less successfully correct them. No one is infallible, except the man who pretends to be so only to find himself put cruelly in the wrong the first time he has to face the facts.

Human we are, and human we shall remain. Moulded of mingled competence and incompetence, we busy ourselves

with a knowledge which, though doubtless imperfect, is nevertheless based on fact.

'Cleave with thine axe the rock which bars thy path.'

'Put your shoulder to the wheel!' cries the poet to the teamster whose wagon is stuck in the mud. And good advice it is.

Obsessed by our marvelous faculty of learning, which turn by turn delights and terrifies us, we at first sought its source in the unfathomable depths of mystery instead of painfully reconstructing its history from the development of phenomena which we have under our eyes. In spite of everything, there have existed a few minds eager for enlightenment and courageous enough to pick up the gauntlet that the absolute throws down before our relative knowledge, which, unstable though it be, is corrected by observation.

The oldest science is that of astral movements. Back in the dim ages the Chaldeans partially solved the problem, and in modern times Laplace's hypothesis has been carried to a point which proves many conclusions quite at variance with the religious cosmogonies of the Orient which are still revered in drawing-rooms and in temples — science to the contrary notwithstanding. All our studies of the solar system have produced a sum total of positive knowledge bearing on the history of our planet, and greatly enriching it. We can now reconstruct the major transformations of its past of which its present activities are the inevitable consequences. Step by step we can follow the successive stages of the cooling of the world from the explosions of the incandescent mass to the peace and beauty of to-day. We can speak with assurance of the results of that cooling, and we can predict the consequences. Should it surprise us that, as in all other sequences, we are ignorant of certain transitions which occurred when the organic complex of the cell and its plasma replaced the inorganic complex of the crystal? Is not such the universal law of our relative knowledge? Just because our knowledge cannot be complete, must we close our eyes, lest we learn something?

* 'Prends ton pic et me romps ce caillou qui te nuit.'

Since fire and sword could not subdue the activity of the human mind, let us prove ourselves worthy of preserving and of expanding such elements of our own history as have been salvaged from the wrath of an infallibility which has showed itself so fallible.

THE PREHISTORIC QUATERNARY AGE

If human progress is a series of corrected mistakes, we may say that we owe the satisfaction of attaining truth to our first blunders. I intend no irony. The greatest difficulty is that our span of life is short, whereas the correction of the successive errors by which we expect to discover the truth about the world requires many consecutive lives for the human intellect more or less completely to sort out its atavistic ideas, and to abandon them as whole-heartedly as in the old days it clung to them.

The number of remnants of quaternary man which have been discovered is so far beyond our most sanguine hopes that an abundant literature has resulted. Unfortunately, bold conjecture has often outstripped the purely objective study of facts. It is impossible to count the number of paintings on the walls of cave-dwellings. Some are done in uniform color; some are in black and white; others are polychromatic. In some cases they are supplemented by symbolic emblems, of which some, like the cross, have survived to play a part in the religious life of to-day. Many are real works of art, and some even attain an unsurpassed perfection. Bas-reliefs and grotesque figurines have also been found. A new world came into being. Some enthusiasts go so far as to see in these works a significance perhaps deeper than anything which primitive man could have conceived. On the other hand, theologians stubbornly continue their efforts to reconcile at any cost the new aspect of our history with the legends of Moses. The whole thing is too absurd.

I know of nothing more significant in this connection than a book of mixed science and dogma, entitled 'The Religion of Prehistoric Man,'¹ for which we are indebted to

¹ *La Religion de la préhistoire.*

the distinguished Abbé Mainage, Professor at the Catholic University of Paris. The work bears the *imprimatur* of four eminent censors, who, without mentioning either their scientific or religious titles, declare that they have found nothing in the book 'which would be a bar to its publication.' *Nihil obstat* is their grave dictum. Thanks be to you, worthy Fathers! If the unhappy Galileo had taken it into his head to solicit an *imprimatur* from Rome for his astronomical calculations, the Inquisition bears witness how long the world would have had to wait before Rome gave it permission to rotate!

This learned abbé, however, assumed a preliminarily humble attitude, and thus avoided the scorch of the fagots which in its charity his Church had the habit of lighting. On the other hand, it is to be feared that since to the author the interests of the faith were paramount, his logic may have suffered when it came to reconciling Jewish legends with discoveries of which the Prophets had no inkling. His sincerity is, however, unquestioned. For that very reason his statements are all the more dangerous when they show signs of that type of deviation from truth to which the mind is subject when it unconsciously seeks to adapt facts to a preconceived idea.

For example, Mainage summarily dismisses the phenomenon of evolution. I will not go into his puerile reasons for so doing. Had he held the opposite opinion, what, pray, would have happened to the *imprimatur*? Wholly on his own authority he boldly establishes quaternary man as a monotheist, only to see him lapse, for reasons which he cannot explain, into the practice of gross idolatry. I cannot bring myself to discuss this matter with him on any serious basis. If Jahveh chose to make Adam fallible, what a mistake he made in not implanting his own 'Revelation' more solidly in the heart of humanity!

In seeking to explain the primitive cults vestiges of which still survive in our churches,¹ the eminent abbé tells us

¹ The cult of fire, for example, is represented by candles, which people piously burn when asking any boon, and especially, cures.

that the pure, monotheistic faith of quaternary man (of which faith not a trace remains) was debased by mingled animal spirits and wizardry. This, he assures us, was the first skirmish in the battle between 'man's lower instincts and the rights of God.' But why was there such a battle, of which we, by divine will, are the victims? The great Florentine astronomer soon discovered, when he questioned these 'rights of God,' what forswearing of science they imposed upon him in the matter of the immobility of the earth. However, the Church has had to recant, and we should be thankful that it no longer bursts into our laboratories, torch in hand. Mainage's book even hints that the Church might welcome a chance to compromise. He deserves credit for a gesture of repentance, even if it does not go beyond a gesture.

It is generally known that we have discovered no fossils of man which antedate the quaternary age. It is an accepted fact to-day. Does it prove that man did not exist in the tertiary era? By no means. So far, we have excavated only an infinitesimal area. If for any reason no direct remains should be discovered in the tertiary strata, and if we should continue discussing eoliths, which are not certainly the work of man, we could still argue scientifically and experimentally on the possible duration of evolutionary interrelations.

Before we reach that point, we must acquire the courage to disregard any simple chart of evolution. Having been impressed by osteological comparisons, we have come to accept, after a longer or shorter period of rebellion, the idea of a successive descent. At that point, we turned over to scientists the task of discovering the links of the chain which connects one fossil with the next, and thus of establishing all the coördinations of evolutionary life.

The scientist finds himself in a very different situation. He has his bits of bone; he analyzes them; he compares them, and yet, unless he knows their original surroundings, they do not present a clear picture. The sedimentary deposit in which a given fossil was found may indicate some one page

of its history, but can be made an integral part of the whole only by a knowledge of the length of time that elapsed while the sediment formed. Now, for the various evolutions to have taken place amid the complexities of undefined activities, an incalculable lapse of time was required, and the successive deposits of sediment could alone show the length of that period. Furthermore, since our classifications are merely an intellectual trick, we must admit that cosmic phenomena are not bound to recognize them any more than our approximate analyses which segregate species form an obstacle to the underlying realities of that universal interrelation without which there would be only confusion and catastrophic upheavals. As a matter of fact, it is time which coördinates all the magical feats of evolution.

We are beginning to obtain a clearer understanding of the simians, of the hominidæ,¹ of the pithecanthropes, and of the fossils which combine simian and human characteristics. On the other hand, when by means of experiment and by coördinating our observations we attempt specifically to make our subdivisions precise, we soon realize how far we still are from the goal. I do not imply that our general outline is threatened, but in the vast field of time innumerable offshoots appeared which were bound to merge and diverge into thousands and millions of different forms, ultimately to reunite in the major lines of descent which have been plotted.

There is nothing in all that which runs counter to the natural course of elementary progress. All the forces of the Cosmos are constantly warring in space and time. The law of least resistance determines the outcome. All sorts of vague experiments take place. Only major transmissions of

¹ It being impossible to identify accurately the transition from the monkey to the first definitely human creature, it has been necessary to create this vague genus in which to group the Javanese fossil, and all the pithecanthropic remains which have been, or which will be, discovered. The problem is to span the gap between the anthropoid and the first clearly human man. Necessarily, both ends of the chain are unattached. The continuity of evolution requires that they should be. Obviously there were a great many intermediate stages, complicated by tangled evolutions, a combination of which, through unknown chances, produced present-day man.

energy preserve their identity in provisional forms to which the universal interrelation seems to give the look of a pre-determined scheme, — only, however, if we are willing to accept result for cause. Any one who has studied the complex evolutions which produced mammals will not be baffled by the inextricable windings which led from the anthropoid to the hominidæ and from the hominidæ to perfected man.

Consider for a moment the limitless succession of monkeys, running back into a series of fossil remains, which indicate a multitude of varieties with no conceivable end, and try to picture to yourself this vanished world, so unbelievably prolific. A piece of a jawbone, perhaps a single tooth, will raise up before your mind's eye species without number, representing the irrepressible forces of past evolutions. Bear in mind, also, that the farther one goes back toward the less complex organisms, the greater, proportionately, is their reproductive power. You may well stand aghast before the disconcerting vision of this swarming life from which thinking man is descended.

It may be less disconcerting, though none the less surprising, when, leaning over the abyss, I point out to you a tiny homunculus.¹ It is the tarsier, and it is a remarkably erect quadruman, neither monkey nor lemur. Proportionately to its other members, its brain-pan is larger than that of the pithecanthrope, or than those of any of the hominidæ. It is, in fact, so nearly of the same proportion as our own that one might expect a corresponding mental development. Such an evolutionary product might well upset all our theories had we not discovered as we progressed that universal evolution is like fireworks, which shoot off their sparks in all directions. Hence the bewildering profusion of waste.

Highly developed as is the brain of the tarsier, it shows no signs of circumvolutions. The animal is nocturnal. Because of that fact, it is provided with enormous eye-sockets, from which two huge, strange eyes peer forth and seek to pierce the darkness of the jungles of Java, Sumatra, and Borneo. It lives side by side with the orang-outang,

¹ About the size of a rat.

although of a different evolutionary genealogy. In fact, it has been necessary to create for it a special family, of which it is, up to the present, the sole representative, at least in the living series, although fossil specimens have been found in deposits of the Eocene Age. One of the outstanding characteristics of monkeys is the pronounced development of their arms, whereas in man the greatest development is in the legs. In this respect the tarsier resembles ourselves. Standing erect on a branch with the femoral bone straight as in man, it is very striking by reason of its habitual assumption of human attitudes. It gives one quite a shock to look at it, for it suggests that it is more nearly related to us than are the apes, and it would not surprise me if such were the case.

Inasmuch as all evolutions mingle either to frustrate one another or to combine, our present status is undoubtedly the outcome of an incalculable number of cross-currents of which we know nothing. Creatures of feeble resistance none the less end in maintaining the general trend of the major organic movements toward more comprehensive and consequently more lasting results. To-day, we fully recognize the phenomenon of heredity, but we have not sufficient data to describe its various elements. The tarsier provides an excellent starting-point, and the particular evolution of which it is typical would, could we reconstruct it, probably open up new vistas.

The so-called parietal eye, characteristic of certain reptiles such as the *hatteria* of New Zealand, caused scientists much surprise. Indisputable traces thereof are found in many fossils. It has even been claimed that our pineal gland is the remains of a third eye which we originally had on the top of our heads between the parietal bones. I am by no means sure of this. However, the third eye of the *hatteria* permits us to visualize many evolutionary chance developments, like that of which the tarsier is a living example, between the sensibility of the skin to light and the pigmentary spot of the infusorian on the one hand, and the human eye on the other.

The simple fact that some fossil ape of the pliocene age is more closely akin to us than is a present-day chimpanzee clearly demonstrates that although general evolution may be unquestionably established, it by no means follows that it progressed directly along the lines of the evolutionary development of organisms, as we to-day see them. Evolutions of which we know nothing succeeded each other with countless ramifications until they resulted in present conditions. In the living world of to-day the exhausted evolutionary processes do no more than to illustrate, in a few characters, the fact that there has always existed a very ancient stock which is common to all of us.

It will always be difficult accurately to classify the fossils of lemurs, of apes, of anthropoids, of hominidæ, and of clearly defined man of the primitive ages. I like to apply the term *pithecanthrope* to the man-creatures of Trinil. The Cro-Magnon skull is obviously that of a man. The question is whether the skulls of Chapelle-aux-Saints and of Neanderthal are skulls of speaking men. Many people think not. On the other hand, how can one talk of a *man* incapable of articulate speech? Is a thought expressed only by a cry really a thought? Ideas take shape because of the effect which speech has on them, and, in turn, ideas react on speech to make it more precise.

Another situation, similar to that of the chimpanzee, exists in the case of catarrhinian monkeys (monkeys with nostrils set close together). Fossil specimens of the latter indicate that they were more like man than they are like contemporaneous types. The chimpanzee, the gorilla, and the gibbon (all anthropoids) existed in the pliocene age, and the chimpanzee even in the miocene. It has been suggested that we must go back to the upper eocene strata — which are the latest of the earliest deposits of the tertiary period — before we may hope to find the common stock of both anthropoid and human beings. In other words, it is now recognized, in spite of our meager exhibit of fossils, that we are descended from a tremendously remote period, inasmuch as we are obliged to go back to the earliest vertebrate types,

such as the amphioxus and even the ascidian. Perhaps the stretch from them back to the first forms of life may be as great as that between them and us. Time and space are the determining factors in the formation of the universe. They produce unending chains of interrelated phenomena, which resemble miracles, and which result in coördinated, evolutionary groups.

In the present state of science osteological proof of the existence of man in the tertiary age cannot be produced. It is even a debatable point whether the more or less roughly hewn flint implements found in the pliocene and miocene deposits indicate his existence in those periods. Eoliths have too many accidental resemblances to permit us to base any conclusions solely on their appearance. In England, in the upper pliocene deposits, stones which look as though they had been shaped have been unearthed. In fact one of these stones was imbedded in the bone of an elephant of the pliocene age. I am inclined to consider this discovery as almost too good, for it would be difficult to imagine how a hunter could have succeeded in actually embedding a simple stone — which would have been his only weapon — in the bone of such a huge beast. Even if one supplied a man of to-day with a long-handled axe, I doubt whether he could accomplish such a feat. I do not like the interpretation of the facts, but I can offer no alternative except the supposition that the beast fell on the implement. It seems more plausible that the phenomenon was caused by the weight of the animal falling on the stone than that the stone should have been driven through such a tough skin.

In Argentina a number of quartz arrow-heads have been found firmly stuck into fossil skeletons of animals. These discoveries, however, prove nothing, for the allegation that the arrow-heads were made in the miocene age has not been sustained. Obviously, the skeletons belonged to animals of the quaternary period, or of the pleistocene at best.

Even though we have no conclusive evidence that man existed in the tertiary age, the best informed scientists conclude that, in all probability, and, in fact, necessarily, he

did. Their reason is the incalculable length of time required for a series of evolutions which take place only through complex divergences and convergences which we cannot define.

Ample material is available for an historical study of quaternary man. In France, a great number of cave-dwellings, which are probably the best examples, have been scientifically explored. The resulting discoveries are available to the public. Photographs, perspective drawings, and descriptive monographs have provided even the ignorant laity with the approximate information necessary to talk about the subject. Much has been learned, and, doubtless, even more remains to be learned. Many superficial hypotheses have been advanced, for, in that field, any one may disport himself at will. I propose, however, to restrict myself to a few theories which, to date, seem established.¹

I should like to enter fully into the problem of the transition from the anthropoid to finished man. It is a subject which is quite as interesting to the general public as it is to scientists. However, I can only touch here upon the salient points. When people who for the most part are ill-equipped take up the question the chances are that their conclusions will be distorted and false.

Originally, people had the idea that the only problem was to discover the so-called 'missing link' between the anthropoid and man, and that when that had been accomplished, all existing uncertainties would vanish. Some complete and obliging skeleton was expected to rise from its grave and say, 'Here I am. I've been waiting for you.' He would be congratulated all round. The good creature would be subjected to all possible measurements; its joints would be exercised, and then it would be enclosed in a fine glass case, marked 'Hands Off!' Idiots would flock around, and would ex-

¹ As no evidence has yet been produced that tertiary man existed, it is generally conceded that the mural art of the cave-dwellings does not antedate the age of reindeer, that is, the latter part of the glacial period in Europe. However, even earlier than the highly developed art of the caves of Dordogne and of the Pyrenees, there were various rough sketches as a great many hasty pictures drawn on various objects, such as weapons and tools, and even on rocks bear witness.

claim, 'I've seen it.' And they would have no idea what they had seen.

Matters are not so simple as that. I have already pointed out that it is a mistake to look for hereditary evolutions in the sequence of any single genealogical development. Many as are the species of which we have relics, many more must have vanished without leaving any direct traces. Species overlapped each other, merged and crossed, and as our sole means of identifying the direct line of descent, left us only various of its offshoots. Hence, fossil fragments are laid out on museum tables, and from them, following Cuvier's law, we reconstruct a more or less accurate whole. The next minute we endow the new specimen with a descriptive name. All that remains to do is to compare it with the oldest skeletons of the quaternary age and to deduce appropriate conclusions.

A biological interpretation of the meaning of fossils presents a very different picture. We have not, and we never shall have, an anthropoid unit to compare with a human unit, together with intermediate units. Universal organic evolution does not permit it. Consider the variety of types of present-day humanity and remember that we see only the results of countless differentiated evolutions from which in the course of countless ages sprang types of unknown origin. It is a long step from the present Papuan to the civilized man of to-day. Retrospectively, it is just as long a step from the Papuans to the man-ape of Java, and it would be a much more enlightening one if we had a sufficient number of specimens. By comparing many series, we might perhaps obtain now and again definitive light on the way in which the links of the chain are joined. Alas, that is but a dream. Those intermediate types have disappeared, and are beyond our grasp. Of a few, the rare fossil vestiges which we have permit us to glimpse transient coördinations at most.

That, however, is sufficient to confirm us in our belief that we hold Ariadne's thread. The more remains of the hominidæ, or pithecanthropes, we find, the greater the num-

ber and diversity of types we shall have to illustrate the evolution of one into the other. Of the fact itself there can be no doubt since remains, incomplete indeed, but highly significant not only individually but as a group, have conclusively proved the fact of filiation.

At Trinil, in Java, a brain-pan, two molars and a large human femur have been discovered, in which simian and human characteristics are fused.¹ The brain-pan is of a type morphologically halfway between that of the chimpanzee or of the gibbon and that of archaic man — such as the Neanderthal man or the man of Chapelle-aux-Saints. The inner surface shows circumvolutions the character of which places it between man and the gibbon. The femur is more nearly human. In fact, it is the femur of a man who stands erect. *Pithecanthropus* of Java may have been one of the last of his race if, as many people think, he was a contemporary of already evolved man. This theory is supported by the fact that along with the human remnants dug up at Trinil were found evidences of primitive industry. I am forced to hide my face when I wonder whether there may not have been mixed unions — men and apes. It is shocking to think that, perhaps, our direct ancestress of the quaternary age (of whom her contemporaries have left us no very flattering portrait) suffered the indignity of having some young *pithecanthrope* with a merry eye turn from her in disdain. Asian and Greek myths might lead us to believe that such things actually occurred. Whether or not we find that, as Boule maintains, the Javanese *Pithecanthropus* was related to the old fossil gibbon found in the tertiary strata of Egypt, is immaterial. All we should have accomplished would be the discovery of one more item in the general confusion of dubious descents.

¹ It is thought that in those days the islands of the Malayan Straits and those of the Japanese Archipelago were part of continental Asia. Many people are of the opinion that humanized simians first appeared in Asia. Darwin, on the contrary, thinks that they developed in South Africa. Why may not both hypotheses be correct? Nature is prodigal of her phenomena. No greater organic evolutionary effort was required to produce a result on one continent than on another.

Did the jawbone at Mauer¹ belong to a man or to an anthropoid? It is heavy and powerful. Some of its characters resemble those of a gibbon. The teeth indicate a human face; however, the chin is almost lacking. By some it is claimed that it belonged to an ordinary ape, by others, that it is closer to the Javanese fossil. Since we are not called upon to express an opinion on this particular case, the most important thing is to note that the simian and the human characteristics are so merged in a single anatomical remnant, that there can be no question of the relationship between the two evolutions.

Next we come to some remains unearthed in a gravel-pit at Piltdown, near New Haven, in Sussex and said to be of human origin. Two skulls, of which one is incomplete, one lower jaw, the half of another, nostrils and one canine tooth have been found. Authoritative writers² consider the remains as those 'of a very ancient type of *homo sapiens*.' Boule, on the other hand, thinks they belonged to a chimpanzee. 'It is a remarkable coincidence,' says Joleaud, 'that on two separate occasions a human skull and the jaw-bone of a chimpanzee should have been found together.' I agree with him. Is it to be presumed that the skull and the jaw-bone belonged to the same creature?

I pass over the less important discoveries, but must stop to comment on the 'man-monkey,' recently identified in South Africa. Professor Dart of Johannesburg contributed a most interesting article on it to 'Nature.' The remains consisted of a skull, an endocranium, and some chalky rocks containing bits of bone. With considerable difficulty, the skeleton of a face was excavated from the rock, of which photographs have been published. In the magazine 'Anthropologie,'³ Boule ably comments on Dart's article, in which the latter, without going so far as to assert that the specimen is that of a human being, is positive that it represents a higher type than that of the known anthropoids.

It is not for me to take part in the controversy which

¹ Near Heidelberg.

² L. Joleaud: *Éléments de paléontologie*.

³ Vol. xxxv, no. 12.

this African pithecanthrope has raised. Boule seems to think it a chimpanzee. So far no clue has been found as to the geological age of the fossil. It is better to wait until further and perhaps better coördinated data are forthcoming. At the moment, it seems difficult to discuss intelligently 'the humanoid rather than the anthropoid nature of the subject.' It must be said that the photographs strikingly suggest the expression of a human face. Whatever may be the outcome of the controversy over this South African 'man-monkey,' the question whether the genealogy of man and the genealogy of monkeys merge at some point can no longer be debated. The span between the skull of Pithecanthropus and the skulls of the Neanderthal and Chappelle-aux-Saints has now been bridged. Even before this last discovery, we had the jawbone found at Mauer, still unclassified, but akin to the Javanese type.

In the pliocene age the men of the Mauer and Trinil types were contemporaries of the giant hippopotamus; in the middle pleistocene age the Chappelle-aux-Saints or the Neanderthal man was the contemporary of the mammoth, and in the upper pleistocene age the Cro-Magnon man was the contemporary of the reindeer. All were closely connected. Men of the Chappelle-aux-Saints type made their implements of chipped flint, were familiar with fire, and lived by hunting. From the present point of view they were very backward, yet very advanced in comparison with the Javanese race. The connection between the two may have been direct or indirect, and it is quite immaterial whether or not cross-breeding took place.

It is by no means established that the cave-dweller represented the first link in the primitive human chain to which the humble pithecanthrope can claim direct kinship. The exact period of the quaternary age at which man appeared is a much debated point. However, and if ever, the question is settled, the fact will remain that even at that date our ancestors had behind them a long and inarticulate history when the urge to express themselves by crude means stirred in them.

This then is a period in the evolution of present-day man which is of vital importance, and of which for a long time we were ignorant. It may be a disappointment for those who were searching for a 'first man' not to find him here. The first man was a composite of many connecting strains of which we try to determine the stages. Reducing the matter to elementals, the Neanderthal and Chapelle-aux-Saints skulls are those of men of a much earlier period than the Cro-Magnon skull. Could men of the Cro-Magnon type talk? It is possible, but, pending further information, one can credit them only with a very rudimentary form of articulate language. The top of the skull of the Javanese pithecanthrope raises many suppositions which awaken grave doubt whether it belonged to a man or to an anthropoid, and, if to the latter, to what order of anthropoid. It becomes increasingly obvious — all cosmogonies based on 'revelation' to the contrary — that it is most unlikely that we shall ever discover the remains of an erect biped mammal which after considering all the evidence we can identify as the long awaited 'first man.'

The chief reason is that the morphological evolution of the general structure and the slow development of its activities, require an incalculable length of time to accomplish insensible transitions which at best we could only grasp by induction even if we had the actual specimen before us. If such be the case, how is one to reach a definite conclusion about the sum total of characters and draw any hypothetical line of demarcation between the most human anthropoid and the least ape-like man, especially if, as unquestionably would be the case, they traced their ancestry along numerous different lines of descent?

We must make the best of the situation. We must accept the fact that the subject of our study will never appear before us except in the form of remnants of a sort which will, perhaps, permit us to draw conclusions based on inter-observations inductively associated. Even if we had all the skeletons which have been reduced to dust, the endocrania would not allow us to grasp all the imperceptible transitions

in a gradual mental development. Between the cogitations of the last anthropoid and the incipient thought of the earliest man, we can expect to find only a scale of mental tremors rising by degrees to that differentiation in which the original characteristics of human consciousness assumed definite form.

Such views will undoubtedly shock many good people, into whose inherited ideas, based as they are on archaic religious reflexes, science can gain access only by slow stages. It goes against the grain to visualize primitive man as he really was, namely, inferior to our lowest savages. Yet his remains indicate that such was the case. What we want to do is to see ourselves, modern men, living, not only in the cave-dwellings of the quaternary age, but even in still earlier ages. We want to find duplicates of ourselves even in the days when near-men and near-women perhaps hesitated among unions some of which might throw back future generations to the condition of primitive man. Furthermore, we persist in looking for dramatic climaxes in the history of phenomena, whereas organic evolution, of which we are the product, was accomplished through scarcely perceptible transitions.

Another error which I have already referred to is that of expecting any single line of descent to be visible in the fossils on display in museums. The indefinitely multiplied evolutions imply an incalculable number of differentiated variations springing from a common stock which supply us with a great diversity of examples in every degree of development. It is, therefore, impossible always to find the direct connection between definitely analogous fossils that we interpret in the sense of the strict dependence of a continuous succession. As all these movements start from a common origin, what does it matter, since they leave along the road sufficient identification tags to permit us to recognize the similarities and dissimilarities, the final outcome of which must inevitably be an evolution from a common root to a series of sharply defined effects?

All this in no way affects the problem of a general line of

descent, which may spread out or contract without the specific characters' undergoing any marked deterioration. 'The roots of the original trunk of present-day humanity,' writes Professor Boule, 'are sunk in a past of much greater antiquity than until recently people supposed. In all probability, the lines from which the anthropoid and the pithecanthrope issued do not meet in the common trunk, from which monkeys also issued, except at a very remote period. Thus, the paleontological evolution of the human race is closely connected with the evolution of many mammals, such as horses, elephants, bears, etc. . . .'

To this the Abbé Mainage responds with the question: 'Whence comes *homo sapiens*? Is his ancestry *wholly* animal? To this question *faith* can make but one answer.' That is getting out of the difficulty too cheaply, since the question is not one of faith, but of scientific facts. On the one hand stand the museums, on the other the churches. Are they to agree or to disagree? That is the ineluctable question. It must be answered.

The paleolithic sediments — lower, middle, and upper — contain most of the fossil bones of our ancestors. As is natural, the greatest number are found in the layers which are nearest the surface. I make no comment on those geological eras of which the duration varied, but which consumed millions and millions of years. The history of those periods is wholly beyond our power to estimate, but it cannot be ignored if we wish truly to observe.

I cannot linger over the study of prehistoric implements which has, however, led to highly interesting generalizations. Minute descriptions, borne out by photographs, have been published. Implements have been classified with great care, according to the character of their origin and of their purpose. Supplies of raw material were undoubtedly the reason for many temporary settlements of which we shall never know. That, in itself, indicates a distinct stage in those prehistoric times which succeeded the primitive ages when man was satisfied to use as weapons any stick or stone which came to hand.

Because flint could be chipped into almost any shape, man adopted it as a medium in which to copy things which he had picked up, and which had proved useful. Classifications of implements according to the localities in which they were found have only a mnemotechnical value. The broad view demands that instead of losing ourselves in categories valuable to museums we should seek in the adaptation of the tool to various uses and in its artistic quality the trace of a simultaneous evolution of thought and of art. When we have classified all the varieties of axes, knives, arrows, spears, fish-hooks, scrapers, pestles, graving tools, polishing tools, and drills, we shall have a fair idea of the extent of primitive industry. But, in doing so, what a huge number of uncertainties we shall come across! That might be an additional reason for narrowing the problem, and some day that will be done.

We see paleolithic man armed with a club, which later, by a process of evolution, became a mace in the hand of Hercules, representative of primitive power, and later still the sceptre of royalty. Originally the club was only the crutch whereby early man maintained himself in his recently acquired upright position. Stones served as missiles, knives or pestles, according to the exigencies of the moment. Huts made of branches, constantly in need of repair, or rocky cavities which could be enlarged by working friable rock with hard stones, supplied shelters. The search for a roof was a great incentive to man to seek and to utilize new combinations of means. Before long, he bethought him to combine a stick and a stone into an axe, a spade or a hammer. The primitive axe, made of chipped flint, at first roughhewn, came to be polished, and in this small progress in form and finish neolithic man took a step in which we can see even an aspiration toward beauty.

Inevitably, other progressive steps accompanied this particular one of which we have conclusive evidence. Unfortunately, we shall never be able to describe them. However, in the domain of art, the data that we have show a fine æsthetic sense. The paintings, drawings, and modeling found

in cave-dwellings have rightly stirred our admiration. Our greatest problem is to establish a chronological order of production, since the earliest efforts could not possibly have left any lasting traces.

It is quite certain that the workman, the artist, of the paleolithic age did not succeed in perfecting his art, as we know it, over night. His first awkward sketches were necessarily defective and were rejected as he increased in skill. We have found others which, although unfinished, clearly indicate the purpose which the maker had in mind.

An exhaustive study of paleolithic man in his workshop would be intensely interesting. Museums often become storehouses which students of their contents hate to go outside of lest they find elsewhere new material which would change their preconceived ideas. I should very much like to see a series of preliminary sketches and compare them with the finished products. Retouched work is especially significant. In natural eoliths we can see how an article which happened to be useful suggested improvements and how man tried to effect them. That was the beginning of industrial progress. It seems to me that when a series of imperfect implements show some sign of an identical inspiration, even if faulty, we should note it as indicating the workman's intention.

Not until we come to the pictures on the walls of cave-dwellings do we enter into the field of those thoughts and actions which are generally classed under the name of 'paleolithic civilization.'¹ It was to be expected that these manifestations of an æsthetic or utilitarian impulse should have been found mixed together, no matter whether they belong to the same epoch or not. The fact that paintings were superimposed on others proves that when the occasion favored, artistic rivalry showed itself.

Pebbles found in various places show amorphous beginnings, like the work of a child trying to do he knows

¹ Bracelets, combs, necklaces, and various articles of finery show that these primitive people felt a desire to adorn themselves, a savage craving for beauty the root of which Darwin strains a point to discover in animals.

not what. It is often hard to distinguish between water-worn stones and those which bear the marks of human handicraft. Some specimens show an unexpected degree of observation, in spite of inexperienced workmanship. Then came veritable works of art — free engravings and even carvings in full, high, and low relief on hand-made articles. Stone, bone, horn, ivory, and wood were the materials used. In course of time the cave-dwellings were discovered, and their pictures spoke.

Come forth, ye mammoths, rhinoceroses, boars, wolves, horses, reindeer and all manner of horned beasts; come, also, ye bears, bison, aurochs, bovines of every sort, ye great felines, fishes, snakes, birds, and lastly ye of the human race who aim to progress from the engraved sketch to work in color and through simplification of outline to a style suitable to lack of skill in search of easy methods! ¹

The art of the quaternary huntsman is what first stands out conspicuously. As yet we find no evidences of domestication, except perhaps in the case of the horse, the finish of some of the pictures of which seems a sign of habitual intimacy. Some pictures depict stags and bison with arrows piercing their sides; in others they are shown in the center of a flight of arrows. Hunting tended to make men nomadic. There are no traces of flocks or of shepherds, or as yet of agriculturists. Naturally, we are tempted to speculate whether these folk may have had some vague form of religion.

I hardly know how to classify certain rough sketches of human profiles which are found side by side with faces done in minute detail. Then there are free sketches awkwardly obliterated. There are not many human figures; there are, to be sure, some realistic sketches of women which make it clear that feminine charms had not reached their perfection. Ithyphallic dances performed by female figures

¹ Attention has been called to the similarity between these early paintings and the simplified Japanese drawing which trails off into calligraphy. It is a curious fact that people have claimed that a certain 'decadence' is discernible in certain of the series.

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dressed in costumes not unlike those of to-day — except that they were more modest — are not uncommon. There are also inexplicable signs, among which the hand seems to have that significance of power,¹ which, as in the case of our 'hand of justice,' it still has to-day. The same is true of the equilateral cross, which appears simultaneously in the most ancient times in countries between which no possibility of communication could have existed, such as, for example, Dordogne and South America.

How are we to interpret such a collection? As religious manifestations? Fetishes? Myths? Rites? I omit any consideration of the hypothetical history of this art, the purpose of which most certainly was not a desire to gratify contemporary man with an exhibition or a salon. It had nothing to do with 'art for art's sake.' Probably, men, and especially hunters, saw in the course of their daily wanderings enough animals not to want, at least at the start, pictures of them in their homes for purely æsthetic reasons.

It is questionable whether these tunnel-like caves — sometimes as much as a kilometer in length and often intersected by pools of water — which could be penetrated only by crawling, were really dwellings in the strict sense of the word. In the earliest times, were they not rather chance shelters? In order to drive human beings to shelter themselves in such somber holes, often made uninhabitable by the infiltration of water, they must have been wholly unprotected against hunger, cold, and the attacks of wild beasts and of starving men. Natural caves, or caves dug in

¹ 'And the Lord said unto Moses, Stretch out thine *hand* over the sea, that the waters may come again upon the Egyptians, upon their chariots, and upon their horsemen.'

'And Moses stretched forth his *hand* over the sea, and the sea returned. . . .'
(Exodus XIV, 26-27.)

Before the battle against Amalek, Moses said to Joshua: 'I will stand on the top of the hill with the rod of God in mine *hand*.' And again: 'And it came to pass, when Moses held up his *hand*, that Israel prevailed; and when he let down his *hand*, Amalek prevailed. But Moses' *hands* were heavy; and they took a stone, and put it under him, and he sat thereon; and Aaron and Hur stayed up his *hands*, the one on the one side and the other on the other side, and his *hands* were steady until the going down of the sun.' (Exodus XVII, 9, 11-12.)

friable rock, offered obvious retreats. Of these the caves of the Vézère are an excellent example.

We actually know next to nothing of the dwellings and habits of the so-called quaternary civilization. If strangers were obliged to get their idea of present-day society only from our crypts and church pictures, they would not learn much.

What conclusions should we draw when in a single pile of bones on the outskirts of what, judging from the traces of camp-fires, must have been encampments, we find a mass of skeletons which apparently represent the bones of one hundred thousand horses? For reasons which we cannot determine, something undoubtedly caused innumerable tribes to succeed each other as visitors to that particular spot. Why? How long was their stay?

There are many reasons for believing that these inhospitable refuges, which nature offered to defenseless man, became in time something akin to holy repositories of ancestral traditions devoted to memories of myths and still surviving rites.¹

Why, in the first place, do we always find these paintings, whether crude or highly perfected, which are indicative of a mental continuity through successive generations, crowded together in narrow spaces either at the remotest end of the cave, or in corners which, from lack of light or from difficulty of access, are most secluded? In fact one wonders how the artist could have adapted himself to the conditions while doing his work.

A venturesome explorer, Norbert Castaret, recently discovered at Montespan in Haute Garonne a cave to which access is very difficult. In it he found some very interesting modelings of animals, which were beside some drawings

¹ Primitive humanity was probably much more warlike and more constantly alert against aggressions than is present-day society. Our 'civilization' has spoiled us. If one stops to consider how delicate newborn children are, so far as protection against external forces is concerned, we are forced to believe that the race could not have survived, had not climatic conditions through the long period required for adaptation been favorable. Indeed, the fate of thought was entirely at the mercy of many contingencies!

etched into the rock and similar to those with which we are familiar.¹ To reach them, it is necessary to ascend a subterranean stream, wading in water up to one's arm pits. In the passage leading to the cave and in a fairly large room beyond he discovered a quantity of clay balls which seem to be the remains of some collapsed modelings. They include the fore and hind quarters of feline animals. In fact, what appears to be a representation of a tiger, one meter sixty centimeters long by one meter high, is recognizable. The bodies are mutilated by numerous spear thrusts. What unknown rite is implied? There is a cave-bear lying down in the attitude of an Egyptian sphinx, and riddled with wounds. Everywhere, there are many figures modeled, some in high, some in bas-relief.

As usual, premature explanations have been forthcoming. Personally, I think it wiser to defer judgment. The evidence points to magical rites; indeed, the lance-points and arrow-heads, modeled in clay, may easily have been used in casting spells.

What may have been the idea which prompted men to hide their works of art — even though they savored of magic² — in such impenetrable hiding-places? A man must be unusually active to be able to examine them, and merely to look at them requires a posture that cannot long be held. There is a strange parallel between Michelangelo, on the

¹ It should be noted that there are artistic outline drawings of little chickens which are not shown in the published illustrations.

² It is no longer a question of trying to differentiate between magic and religion. To be sure, sundry prejudiced persons still try to do so, lest their cult suffer from the association. Magic and theurgy represent methods of putting man into direct contact with the Invisible Power and even of making it bow to his will — if he can. Do not priests through the medium of prayer, ecstasies, visions, and especially communion, try to put the faithful into personal relationship with God? The earliest Brahminic rites were intended to control divine will. Our own religious ceremonies aim at the same goal, but with no great chance of success. Magic, claiming as it does to be efficient, has its ritual place in the origins of all religions. It has survived even to the present day among contemporaneous savages. It flourished in the time of Louis XIV, when Mme. de Montespan had the 'black mass' performed over her naked body as a means of winning back the love of her royal lover. Magic still holds an important place in the minds of uncivilized people. However, men of sound intellect are evolving!

top of his swaying ladder in the Sistine Chapel, arguing with Julius II, who wanted to see the master's work before it was finished and before the master wished him to do so, and this strange, acrobatic painter of the cave-dwellings, who must have had to work in a torturing posture and in deep obscurity. Presumably these early folk must have had some form of torches, yet there is no trace of smoke. Chemists agree that all trace of smoke has disappeared. But how was it possible that it left no trace either on the carved surface or on the paint? The artist, who did not have his model before him, must, because of changing light, have had to cope with endless changes of 'values.'

The pictures are there — just where we see them, and we must accept them as they are. All cults are full of mystery, and nothing is more conducive to the worship of the unknown than darkness. Of this I became keenly aware in the temple of Allahabad — quite possibly continuing the tradition of the cave — when, through the strange and suffocating atmosphere, I groped my way, nauseated, and lighted only by the flame of a small lamp. Thus I wandered among the crudely painted divinities of India, and all about me was a tide of the ghostlike faithful, silently bringing their offerings of fruit and of flowers, doomed to rot in a holy atmosphere. The English have, nevertheless, wisely seen to it that the darkest corners are dimly lighted. What could the place have been before?

Our cave-dwellings do not contain many pictures of human beings. There are a few distorted profiles, women, perhaps in ritual attitudes, but so violently realistic, so utterly devoid of any beauty, that it is hard to predict from them the coming of the Venus de Milo. The drawings of men are conventionalized to such a degree that the convention obliterates the reality, which seems a strange lapse of the power of observation, often so acute. Why was so much emphasis laid on the animal element, and so little on the human? Throughout the whole of the art of the quaternary period, the unbelievable contrast between the painstaking detail with which various pictures of animals were executed and the

crudity of the representations of the human form seem to be strong evidence of a mythic symbolism of the animal fetish (the totem), before which man bowed down as a humble worshiper. The early artists must have studied nature in her other manifestations before they paid attention to their own likenesses. Furthermore, feminine grace as yet asked for no other mirror than that afforded by the near-by pool. Perhaps those pictures which represent the battles between men and beasts should be considered as ritual glorifications of the chase. At this period there must have existed other rites, of which some have survived, as the ithyphallic dances of the ladies of the quaternary age go to prove.

It is significant that no pictures have been found which portray conflicts between human beings. Certainly, this was not for lack of models. Versailles will convince any one that not to paint pictures of battles was a custom which did not survive!

Finally we find a few paintings of the sun (a radiant circle) and of the moon. These seem to indicate that man was fixing his attention on the heavenly bodies, and that for purposes of worship he felt himself obliged to draw pictures of them. This is the first symbolic sign of an emotional development which later became the actuating principle of incipient religious cults. We find no drawings of fire, although men must have been familiar with it.

It has been maintained that the paleolithic paintings present the earliest evidence of human religion. Personally, I should consider them rather as magic ritual, for between these pictures and the first religious acts a long period was to elapse. The imprints left in the clay by people squatting on their heels prove that a group had assembled for some sort of ceremony. But before I can agree with Mainage that this confusion of beasts, of neighing horses, of fighting bison, of running boars, and of befeathered men performing symbolic dances, represents the 'one and only God,' already much deteriorated, I shall have to be shown some fact in support of such nonsense. For the moment, I am obliged to regard them as representing quaternary man in his pro-

pitiatory rites. I accept him as he is, along with his complement of animals, to which, without entering into the complications of totemism, I am quite willing to concede the character of 'sacred' beasts.

A great to-do has been raised over totemism. Fundamentally, it is only a survival of animal worship, associated with clan and tribe life, in which the totem plays the part of a sort of collective talisman.¹ The fact that a plant, or even some inert article, is sometimes substituted for the animal shows that it is merely the product of various intermingled cults.

Regardless of what has been said on the subject, there are no authentic traces of totemism in the pictures of the quaternary age. That does not mean that even in that period primitive groups may not have formed around a talismanic animal. But we have no conclusive evidence. It may well be, however, that some tribe, or some clan, or even some man, took the name of an animal, or of a plant, or of a rock with the idea that it would afford him special protection. In the reciprocal relations between protector and protected, certain social rites may well have come into existence.

We find curious traces of these rites in the customs of the natives of North America, and especially of Australia. Hence I readily conclude that at a vaguely defined period man had reached a certain degree of religious development and some aptitude for social life. However, I see no reason for deducing therefrom, as some people have tried to do, the existence of anything resembling a religious philosophy. In all fields of thought, has not metaphysics given free rein to its ingenuity? Painstaking studies of totems have produced one valuable result. Quite often contrary to the intent of their authors, those studies have pointed out certain blind alleys up which it is obviously unwise to stray.

¹ I have personally observed that in Brazil military bands never go out on formal parade without taking along a sheep. The same is true in England, only there a goat takes the place of the sheep.

A discussion of evolving man's relations to the living world would open a field far too wide for me to enter. Necessarily, the earliest society of humanized anthropoids was of the most rudimentary sort. Monkeys afford us excellent examples of the social instinct. A mob of them will suddenly rush off in pursuit of no one knows what imaginary object, which they will suddenly forget as some new whim strikes them. They are essentially lacking in the power of continuous, steady effort toward a definite aim. They have no 'character.' There is a marked similarity between these actions of theirs and certain activities of the human race!

From the time of the totemistic fetish to that of the sacred cow of India the final accounts of the cultural relations between animal and man were regulated according to religious forms that sometimes led to excessive familiarity between the god and his worshiper. Benares continues to suffer the tyranny of the sacred cow. It is well known what store the Romans laid by their holy chickens.

To the remains of a fetish-cult adapted to the earliest needs of a savage mentality can be traced the origin of that rite of alimentary communion which deteriorated into the excesses of theophagy, whereby the totem-worshiper sought to assimilate something of the divinity. Is it not true, even to-day, of our contemporary theophagists?

One of the rites of the Dionysiac cult was the dismembering of victims while they were still alive. The flesh was then eaten raw on the theory that it would impart to those who ate it something of the divinity to which sacrifice was being made. The legends of Orpheus and of Pentheus contain similar episodes. That is homophagy. A goblet in the British Museum is decorated with a scene wherein two drunken mænads are brandishing, one a leg, the other an arm of the sacrificial victim. Before the battle of Salamis Themistocles sacrificed three Persian prisoners, but nothing is said of their having been eaten. To-day, theophagists limit themselves to purely symbolic performances, an advance which is to their credit.

MEGALITHIC MONUMENTS

Along with megalithic monuments we are surprised to find innumerable proofs of widely-spread human settlements. Over and over again we find analogous arrangements intended for some unknown purpose. The simple enumeration of them would be tedious unless it were accompanied with a comparison of the arrangements from the crudest structures to those of the advanced stage represented by corbelling. We have discovered trunks of trees, branches, structures of peat, hardened mud reinforced with stones, walls of hewn rock, stone implements, remains of cooking apparatus, remnants of warehouses containing bits of food, parched fruits, bread in flat cakes, and piles of charred wheat. Of a later period, relatively highly developed bits of architecture have been found, but what their purpose was, we cannot tell.¹ All these many remains, dating from indeterminate times, illustrate the development of human settlements from the remotest ages down to the beginning of that primitive knowledge which reveals an incipient effort at organization.

So far, we have been unable to classify these mute relics, or to establish anything like a sequence in the history of man's intellectual and moral progress. However, we are at the very beginning of the task. Hypotheses are not exhausted.

On all sides we see megalithic monuments which in ancient times were connected with funeral ceremonies. In the case of dolmens it would be instructive to know whether the skeletons which are sometimes found near by were contemporaneous with the monument. It seems highly questionable. The tumuli, which are often built over dolmens, or over what appear to be the beginnings of dolmens, are more likely to have been mortuary chambers. The menhirs, at the foot of which remains of human bones have sometimes been found, are probably connected with the phallic cult, which was one of the earliest forms of religion in all countries, and which still thrives in India.

¹ De Nadaillac: *Mœurs et monuments des peuples préhistoriques*.

So many megaliths exist in so many countries that it is quite impossible to catalogue them. They cannot yet be ranged in any scientific classification by definite periods. These monuments mark the transition from purely animal to human manifestations like the cult of the dead which found expression in rites addressed to the fetish, of which certain monoliths were perhaps a representation. Even in those days, the Ego was so dominant that man's first intellectual impulse was, as it still is to-day, an effort to extend life beyond death. This is the reason why the living were supposed to be able to start into action those powers which dealt with the affairs of the future life and with the funeral ceremonies which were to make them manifest. There was as yet no evidence of any rudimentary magic which would in time become an organized religion. How are we to recognize throughout the earliest ages indications of ceremonies of which we know nothing? It is much to have proved the existence of a formal intention, for that is a sure sign of man's initial progress along the dim path of his destiny.

The exact sequence of the psychological states which brought the sons of the anthropoid to the confines of this new world are not known to us. In this connection their necessarily childish conceptions are of secondary interest. The vital point is that they felt the desire to investigate themselves and their world, no matter what provisional conclusions they reached. That desire is the first positive sign of an incipient intelligence moving toward a limitless horizon.

The creation of gods is not entirely the result of an act of pure reasoning. The phenomenon was primarily emotional, as is recognized in the aphorism that fear is the parent of divinities. The emotional reaction which originates in us from contact with the world takes shape in a way which is bound to trouble us, and which is, therefore, far from forming even the beginning of a scientific solution of the problem. The fact is that there are certain activities from which good and evil reach us. That is the first and most

obvious aspect of the adventure of life. The first impulse of human organism, even before thought became coherent, was to put itself on the defensive against the various evils which threatened it on all sides.

Hence it seems probable that in a state of doubt similar to that which led Pascal to suggest his blasphemous bet on divinity, the first religious gesture was one of taking out insurance against harm, regardless of cost. What greater temptation could there be than the temptation to buy a ticket in each and every lottery, especially when they cost only a few words!

No matter from what angle one considers the problem of the origins of megaliths, it seems to me out of the question not to attribute to them a religious character. If they were merely commemorative structures, they would not be so universally found. The uniformity of their construction seems to preclude the possibility of their having been mortuary monuments. What is perhaps most remarkable is that in every habitable part of this earth we find the same structures characterized by the same elementary architecture. Invariably they consist of huge, uncut blocks of stone, either superimposed upon each other or aligned as a child might arrange a set of dominoes. These collections of gigantic stones seem to indicate a simplicity of conception and a poverty of means incompatible with the builders' apparent facilities in the way of transportation (of which we know nothing) which could produce the results we see. Even hypothetically, the problem seems insoluble, especially when one is confronted with the evidence of an almost superhuman effort which successively or simultaneously created these monuments all over the inhabited continents of the world.¹

¹ Louis-Philippe was so proud that he had been able to erect the Obelisk in the Place de la Concorde that, around the base, he had engraved and gilded as a lasting memorial a picture of the instruments used in the operation. Several thousand years earlier the Egyptians had performed the same feat, without feeling any particular pride in the achievement. What shall we say of our primitive men who built their dolmens and their menhirs without for an instant suspecting that succeeding centuries would produce a Louis-Philippe and his ostentatious machinery?

No matter how far back we trace the history of races, the general scheme of rudimentary social development contains various manifestations of the gregarious instinct to which each group clings the more tenaciously, the more peculiarly individual to it they are, and which indicate an uneven evolutionary progress. Racial characteristics and environment jointly explain the phenomenon. How, then, can we account for the fact that entirely dissimilar peoples — some in a state of savagery, others having attained a degree of intelligence and a body of customs which put them on the winding path leading to future civilization — should simultaneously have passed through the same evolutionary degrees? How did they happen to erect all over the world identical structures, indicative of an identical state of mind?

It is easy to understand that the first mental activity should have expressed itself in similar ways; that the same dangers stimulated the same methods of defense; that the same requirements produced the same instruments of primitive industry, just as the same vanity of dress was responsible for the same type of ornaments. No one is surprised that everywhere in all lands, we find among the rocks of various tomb-structures arrows, axes, hammers, scrapers, polishing tools, necklaces, bracelets, rings, toilet articles, and implements of industry as well as of war. Everywhere the sons of *Pithecanthropus* were originally obliged to face the Cosmos under similar conditions, and it is readily comprehensible that differences did not materialize until after this first stage.

After man had killed his bear or his bison or his boar, and after he had divided the flesh by tearing it apart with his hands; after he had baked his pottery; after he had cast his vase, his weapon or his ornament of bronze, and later forged an iron rod, and after he had in various ingenious ways, protected his family and his home, then the field was clear for those earliest evidences of a common mental and emotional development upon which the general advance of relationships and interests was to be based. I believe there

is no question but that the cult of the dead was one of the earliest signs of that advance. Necessarily, analogous ceremonies came into existence. On the other hand, it is impossible to argue that there is any general identity in the tombs. Death, which so brutally took from each those dear to him, inevitably aroused hopes and longings for a better human state out of which in the course of ages a better doctrine was moulded. Man wanted at the least to perpetuate the memory of the dead by some stone or wooden monument. Apparently, that custom has always prevailed, as it still does.

But how it was possible to accomplish the inexplicable task of transporting and placing blocks of stone greater than those which, with all our mechanical appliances, we can handle to-day, and then to erect them into rooms, with long entrances, and enclosed within a succession of encircling walls, baffles the imagination.¹ The rock-piles in the deserts are easily explained. No other form of monument was possible. A stone stuck upright in the ground universally serves as a bound stone. But the transition from a simple stone to masses so vast that they seem beyond human power to handle is what checks our eagerness to suggest hypotheses and obliges us to admit that we comprehend less well even than we thought, since we can see no architectural difference in the treatment of potentially privileged persons and the crowd in which all ranks are leveled.

However, menhirs, dolmens, and cromlechs seem not only by their numbers but by their location, to express a certain intellectual state. What is their significance? There is no evidence that it is astronomical. France was originally covered with these collections of rudimentary structures, which little by little were torn down and used to build walls. I have personal knowledge of some which were pulled down and the stone broken up, and of which all

¹ The Serapeum is no less surprising. These enormous monoliths in the bowels of the earth received the mummies of the embalmed 'Bull of Apis.' Perhaps the most astounding feat was that of the robbers who in their quest for jewels moved and replaced vats and lids in these subterranean structures.

that remains are a few shapeless remnants, the original disposition of which can only vaguely be traced by the outlines that are left. But enough of these monuments remain in the world to justify an exhaustive study of their common characteristics as well as of their relations with the districts in which they stand. No one has yet come along who could intelligently attack these obscure problems. De Nadaillac's book on the monuments of prehistoric peoples is nothing more than a sketch, but it is valuable because of the suggestions it contains.

One of the first obstacles in the path of these investigations is the fact that the many peoples who encountered these megalithic monuments were unable to restrain their curiosity and tried to decipher the mysteries of a past of which these huge stones seemed to be the oracular symbols, and at the same time, to inscribe upon them the signs of those beliefs which they were most anxious to connect with the past. But if the primitive architects were unable clearly to express their thought, it is obvious that those who came later could only seek to connect their mental lives with these crude structures by adding new, but no less obscure, signs by way of indicating their own particular interpretations of the monuments.

At certain times it is possible that as a mark of special honor the bodies of the dead were placed under the protection of these monuments. There have even been recovered from one tumulus of earth smaller structures mostly in the form of dolmens made over into mortuary chambers. This relatively easy work dates from a much later time, as is evidenced by the bronze and iron weapons which were found mixed with flint arrow-heads, glass beads, soon followed by wrought gold. Some of these tumuli go back to the dawn of history and are thousands of years younger than the staunch megaliths which stand like sentinels at the cross-roads of time. Often skeletons with their accompanying remnants of humanity have been found under heavy stones on which in times much nearer to our own have been inscribed various signs, probably of a symbolic nature.

These signs consist of collections of curved and broken lines, which, perhaps, represent the vague stirrings of primitive mentality.

Generally speaking, these examples of early writing are rare, and the Cro-Magnon man in the absence of his ancestor of Chapelle-aux-Saints, who perhaps invented the art, has so far kept his secret. Be that as it may, the fact remains that, through the agency of piles of stones the collection of which required a superhuman effort, there has come to us the appealing cry of primitive man whose incipient sensibility at grips with the exterior world betrays its first stirrings. We behold the first activities of human beings, who were beginning to understand that they did not understand themselves, and who had the courage to erect structures on the surface of the ground which represented their questionings, and which were long to await a scientific answer.

It is fully as significant that later generations followed ancestral traditions. They sought to record the suggestive symbols of megalithic thought by vague lines which were intended to indicate emotional impulses long before the crudest symbols made their appearance, and which point to an interconnection between generations in which intelligence was striving to attain what I may call the protoplasms of problems that could not yet be defined.¹ Lastly, the symbol itself, the menhir-phallus, the emblem of generation, and probably of much more recent date than the dolmen, shows the existence of ceremonies which clearly indicate mystic conceptions. This symbol is so persistent that we find it in all groups of the human race, and especially in India where it is still the object of a flourishing cult.

¹ This movement lasted longer than might have been expected. From the moment when in later times megaliths acquired the characteristics of tombs, religious elements were bound to intervene. On opposite pages of de Nadailac's book are the pictures of two dolmens, one on the Oise, the other in India. In each case a circular hole has been cut through the wall of the structure by means of the experienced tool of a much later date. It seems as if the holes had been cut to permit free egress to the 'spirit,' 'breath' or 'immortal soul.' If the hypothesis is correct, this structure is the first monument of metaphysics. Many more exist.

Time pursued its course, and little by little the dolmens became covered with pictures of tools and of ornaments, among which it is possible to identify hands, feet, and even the representation of an unknown mammal. I can only interpret this as evidence of different religions struggling to appropriate a monument the original purpose of which had been forgotten. On a menhir standing in front of a village church not far from Quimper an angel, with traditionally widespread wings, has been carved.

Having no positive data, I am necessarily limited to conclusions based on appearances. I am by no means laying down the law. If the menhir was originally a symbol of reproduction, it none the less became in later times anthropomorphic in character. The distorted menhirs of the Orkney Islands certainly give the impression of a group of people in attitudes of high tragedy. They are the forerunners of the menhirs carved into a crude semblance of human figures, and, through them to the statues on Easter Island, about which we know nothing.¹ All these monuments belong to very different periods. How can we determine within what limits of time they belong? We have no means of knowing. Menhirs are of simpler construction than dolmens, which had supplementary portions, such as the covered entrance corridors and such even as the beautiful edifice at Saumur which may have been a dwelling, a fort, or a temple — and which perhaps was all three at once. It may well be that the dolmen was the symbolic representation of a human dwelling among peoples who had outgrown the hut made of branches. Cromlechs apparently defined a given enclosure, which may have been regarded as sacred. The menhir, which sometimes looks very like a person, more easily lends itself to a variety of explanations.

This series of observations, which I make only in the nature of suggestions, might easily prove that our tipped up stones were the turning point in the evolution from Pithecanthropus to man. If that be so, we may at last have dis-

¹ One of these is in our Museum. The British Museum contains two particularly interesting specimens.

covered the clue to that 'first man' so eagerly sought after. His decisive act would be that he had raised a stone — not a tombstone, but a birthstone — to proclaim to the inhabitants of the world: 'Here am I.' From this simple exclamation, which as yet was in no wise a question, there developed through succeeding stages the entire civilization of our human world.

It would then be possible to explain the human element contained in those huge blocks of stone, which were intended to give a conclusive idea of the mental strain under which our ancestors were conscious of laboring. It would then be easy to understand how this stress and strain, sufficiently widespread to be the first common bond of all thinking humanity, took concrete form in a universal intellectual symbolism which has left striking traces throughout the world. Only a very simple idea could have become so general. In those mysterious ages, the savage who was doomed to remain a savage and the being on the threshold of an evolution which was to make him civilized might, and, in fact, must, have met on common ground. Since both, in terms of their time, were human, that common ground was a sense of themselves and of the world so poignant as to awaken an imperious need for clamorous expression. Arrow-heads, axes, and all the stone implements so widely scattered bear witness to the common starting point from which man set out for his distant destination. The almost insurmountable difficulty of knowing how the great stones were assembled is of less importance in the absence of any means of computing the time that they have stood. The organic need had to be satisfied. And from that time on the great mental impulse which prompted the communion between man and the Cosmos and which dolmens and menhirs had the glory of beginning, was to be ranked among organic needs.

Indeed, the megalithic monuments, together with the religious apparatus that they soon called forth, are the first evidences of a universal human impulse, which the number of cults has disrupted, and which scientific experiment

should tend to reform and indeed has already succeeded in reforming.

I refer the reader to de Nadaillac for the too scanty facts available about the best known megaliths. To be sure, he does not even mention the dolmen(?) at Saumur, which is one of the most important in the whole world. It is a prehistoric palace of imposing proportions, which seems to be the last word in ceremonial settings. Thus we find that megalithic monuments, in their stark simplicity, played their part in our giddy evolution. The austere and ancient structure of the Greek temple, called the 'House of God,' is the direct descendant of the building in Touraine, which is the gateway of the history of man, about to become really man.

CHAPTER XIV

CIVILIZATION

MAN'S FIRST MENTAL STIRRINGS

It would, perhaps, have been wiser had I gone no further than primitive man and left to the reader the task of filling the gap between the man of Chapelle-aux-Saints and contemporary man. To sum up such a history in a few pages seems to me a task beyond my capacity. An attempt briefly to outline the general tendencies of a life at once so diverse and in its general development so homogeneous is an undertaking which could appeal only to the boldness of ignorance. What was I to do? I have striven to penetrate to the roots of the adventure of humanity. The flowers of that adventure are not necessarily a part of my subject. Nevertheless, if evolution can lead our anthropoid ancestor who lived in trees to the intellectual manifestations of our own day, is there anything improper in my briefly noting the progress made and even trying to point out the trend of the future?

Any development of consciousness, of knowledge, and of idealistic aspiration rising from a basis of pitiless egoism, gives us a sense of self-satisfaction which our natural self-complacency does not allow regret or remorse to attenuate. The universe — and man who in his measure expresses it — is an inevitable composite of light and shade. To pass from the primitive human being to the 'civilized' man of our times required incalculable ages, the function of which was to accomplish an evolution no less 'miraculous' than the hypothetical cure of the sick at certain sacred baths. To establish this being, who through the action of his mind and of his emotions is superior to all others, to make of him the custodian of the thought of the Cosmos, and to set him at the incomparable labor of giving intelligible expression to the elements of the universe so that he can draw from his know-

ledge something that will help to increase the convenience of his life, is an enterprise before which every one has a right to quail. How can we find our bearings in such a task?

The transition from the anthropoid to the pithecanthrope produced *homo erectus*, who forever departed from the ancestral trees to tread the plains and the valleys as a conqueror, and there to establish the protection of a dwelling place. As a result of man's dramatic confrontation with the universe, his first questions and his first answers immediately began. Next came the phenomenon of phenomena — the definite appearance of the first *thinking man*. Then finally began the great discussion between man and himself from which was to result the correlation of his sensations, of his thoughts, and of all his other related activities which were to constitute new transitions to new growth. From then on the hereditary transmission of acquired characteristics, and through it of evolutionary potency, worked unceasingly for man's development, and man constantly supplemented and perfected himself through the struggles of his mingled consciousness and unconsciousness. What was to be the effect on his future?

At that point, comparative paleontology, with its fossil proofs in hand, having so reconstituted the genealogy of man as to open to him the field of his continuous evolution, turned him over to primitive history. That history had its bards, later supplemented with the writers of dubious chronicles, who were, perhaps, timid scholars, perhaps heedless observers, men dominated by imagination, poets, or perhaps conscientious scribes capable merely of stringing together with no trace of the critical spirit legends sprung from every sort of origin. There could be nothing better until the time came of the 'thinker' fit to 'think.'

The 'sacred books,' with their imaginative interpretations of the world, are the principal sources of information about prehistoric times, provided always that we are willing to take them for what they are: depositories of the earliest outflow of human emotion before those cosmic

activities the relations of which from the beginning it behooved us to discover in order to adapt ourselves to them. The original reactions of our senses in contact with the exterior world are thus of incomparable value in enabling us to comprehend ourselves, for they supply us with authentic testimony concerning the first knowledge and mis-knowledge in which the original human being was to be entangled until freed by the eventual progress of that verified observation which it was the task of centuries to supply.

Alas, results proved that the evolution of primitive misconception had first to run its course throughout the ages before an incipient scientific understanding could insinuate itself into the compact substratum of the unknown. What happened next? Men of simple imagination, armed with a venerated text never subjected to competent criticism, attached themselves desperately to the misleading letter (rather than to the spirit) and considered it as the one and only means of salvation. The result was that, quite regardless of scientific knowledge and of the generalizations consequent on it, some persons try to compel us to live according to the conceptions of an age in which man could conceive only through his imagination.

The Bible arbitrarily paints man as a simple, fixed organism, enjoying haphazard mental reactions from which all idea of culture, or even of the most elementary mental education, is banished. He possesses only that degree of intellectual activity requisite to obey under penalty of punishment. He has not the slightest idea of any mental development or of its resultant individual and social achievements. He shows not the smallest sign of progress, or even an incipient start toward that destiny which was to make man pass from his original state to that achieved knowledge which is represented as sin. There is no doctrine of any future civilization to follow this chaos — not even the semblance thereof. Without Adam's fortunate 'fall,' which set his sons to work, they would have had no future. What use could they have made of their garden, which did not even need to be cultivated? The sin of our fathers having been

the desire for knowledge, their only resource would have been to sink deep in their native ignorance and to stay there.

Since the trial of intelligence that was to follow was instituted to decide whether it could not all the more safely be trusted because its errors could at any time be rectified, the fate of man was settled the day when he yielded to the evolutionary force which had put him on his feet. Then began the incessant conflict between our greatness and our weakness which has produced our civilization.

OUR CIVILIZATION

What is civilization? ¹ To us the word seems primarily to signify something which is the exact reverse of a primitive life which we boast of having outgrown. That transition, composed of imperceptible changes and of series of phenomena which we cannot trace, extended over an incalculable period of time — incalculable as much because we can lay our finger on no point of departure as because we cannot conceive of any destination. That double circumstance is the reason why every one discusses the matter so glibly, and likewise why any authoritative statement is impossible. The biological phenomenon, however, is proved beyond dispute, and, since the Cosmos is nothing but a continuing series of activities, we must not be surprised if the connection between the *amœba* and Newton is at once obvious and elusive.

The fact remains that stages in that transition can be set face to face for the purpose of suggestive comparison, and if after the appearance of life there is one outstanding point, it is certainly that at which the slow course of mental

¹ The word 'civilization' was still unknown in the time of Bossuet. That great writer, though stopping at the parent word 'civility,' nevertheless emphasizes the quality of the traits which, from ancient times, our ancestors intended it to connote. 'To the Greeks,' says he, 'the word did not signify merely that gentleness and mutual deference which make men fit for society. The "civil" man was a good citizen who regarded himself as a member of the State, permitted the law to regulate his conduct, and coöperated with them for the public good, without undertaking anything against any one.'

evolution came to mark a general condition of sensibility which, in retrospect, contrasts sharply with the humble and crude beginnings of a life that too many subsisting signs do not let us neglect. Under the vague term 'civilization' we designate that group of phenomena which, combined in new forms of vital growth, led man through infinitely complex ways to his own elevation and to the glorification of those social phenomena of which he is the product.

Formerly, the Hotel de Rambouillet tried to give a name to that achievement, and the famous 'Arthenice' obtained from the Salon Bleu a formal vote in favor of naturalizing in the French tongue the word 'debrutalize.' The matter went no farther. The word was still-born. I call attention to it because the idea was correct, and because later it was again taken up, together with the word 'civilization,'¹ when the perfecting of social man became an ideal for which to strive, and which needed a word to express it. The attenuation of organic brutality no doubt constitutes one general aspect of the synthetic forms of the general evolution in which our species engaged. Indeed, it would appear that popular assent, the sovereignty of which even Vaugelas admits, was rightly refused to the 'debrutalization' of the social asperities of a life that was insufficiently 'policée'; that is, refined. The word 'policée,' like the word 'civilization,' implies the idea of a 'city' where the close association of men in contact with one another 'polishes' them, 'civilizes' them, and through refining social conduct produces a man, new both in appearance and in fact. Thus we need regard 'civilization' merely as an organic achievement of the human species, determined not only by the attenuation of primitive roughness, but also by the backward and forward swing between a preservative egoism and a slowly developing altruism.

Altruism, charity, solidarity, are like idealistic fireworks, that is, words which we shoot off at every opportunity, and in so doing we act like our official sower whose lot it is rather

¹ The word 'civilization' did not appear in the dictionary of the Academy until the year 1835.

to gather a sheaf of wind-blown straws than to implant the seed in the field of humanitarian action. The time to consider the matter seems to have come. Egoism, the chief preserver of life, achieves nothing great except through an addition of altruism, apparently inconsistent with selfishness, the effect of which is to stimulate in us an unselfish reaction. On that addition of altruism is founded the capacity for social life among beings who are organically opposed but among whom the interdependence of all the links of the cosmic chain fatally requires complete solidarity. Shall we choose the crude bait of a cheap idealism balanced between the fear of hell and the charm of paradise, or the nobility of an ideal which rises superior to reward — an ideal in which we seek the perfection of a state superior to ourselves, wherein every aspect of evolution, whether known or unknown, unites in a momentary sensation of which self-abnegation may supply the most poignant thrill?

Will the individual man find 'happiness' therein? That depends on his personal interpretation of himself. 'Happiness,' remarks Cabanis, 'consists in the development of the individual.' That is true. Nevertheless, the purpose of civilization is not, and cannot be, to obtain universal happiness. In developing the noblest tendencies of men, civilization increases their personal happiness, but links it with the happiness of others and at the same time supplies every one with extra means of happiness, by which he may or may not know how to profit.

Thus in the immense coördination of the known and unknown complexes of the eternally changing universe, personality continually plays a part in which abnegation of self, uplifting that self above the crowd, exalts it to the highest point in its apogee.

What can we say of the repercussion of our actions on others and on ourselves? When a man must choose between himself and his neighbor he first of all passes judgment on himself in the most decisive and lasting fashion. Whether the balance dips on the side of egoism, or on that of altruism, the impulse towards reciprocity necessarily

leaves a mark. If, through suitable exercise, Lamarckian habit ends in reinforcing the evolutionary process, the activity of our altruism will supply renewed energy for our higher development, which, in turn, will inevitably react on others. Thus we shall make ourselves better and consequently more closely akin to all when we shall have heightened and strengthened the activity of an altruistic evolution in which personal interest and the interest of our human companions are reconciled. And what is even more important, this new achievement will, through heredity, affect our posterity and, by force of example, will spread through the masses, thus renewing their power of achievement.

Hence, instead of our individual action's ending with the organic fact of the deed, we shall see its effect spread beyond ourselves through the natural impulsion of all the related forces of coördinate evolution. Thus will be realized the supreme harmony between the Cosmos and the individual, who can isolate himself subjectively from the complexities that produced him only to take a higher place amid the incessantly clashing elemental activities of a limitless whole. The fact is that life creates complexes of momentary divergences which death, in the mutations of its eternal task of renewal, is bound to bring back to those superior combinations the making and breaking of which mark the rhythm of the universal energy.

Birth, life, and death are, I have pointed out, continuations. In fact they are continuations of continuations without beginning, without end, without stop or pause. Like the projectile issuing from the cannon, the organism shot forth into the mass of complex, irresistible forces, has necessarily (because of inherited tendencies in which atavism and evolution play their respective parts) variously combined totals of velocity, in which egoism and altruism inevitably clash only to be reconciled.

Metaphysics has been unable to do more than fix this passing divergence in the form of hell and of paradise, that is to say, in imaginary after-lives which amount to a procla-

mation of immobility. Because of the rhythms of opposing and coördinating forces which, since evolution leads us to manifestations of the universal and everlasting harmony, are the law of the universe, it is our incomparable privilege to feel that we are joint workers in a cosmic achievement of ourselves, in which we can expend our finest effort, and realize our highest aspirations.

Precisely because it is a question of the noblest accomplishment of our destiny, ignorance, which is wholly impulsive imagination, is only too ready to hold itself excused in the matter of conduct in virtue of various phrases mechanically given out and accepted as being passwords to the gates of Heaven. Primitive culture hardly goes beyond an ingestion of words, and the temptation to be content with them is too great for the average dim consciousness not to clamor over the satisfaction they afford. Long ago I wrote that if it ever occurred to the people who profess Christianity to practice their doctrine, there would be no social question.¹ All the world knows it; all the world sees it; no one suggests beginning. Perhaps the supreme irony lies in the religious ceremonies that are termed 'acts of faith' — *autos-da-fé*. There are men in whom the trials of life awaken higher ambitions. For them I write. And when I suggest that they actually share in the task of collaborating in the great work, they surely will not allege that they find themselves belittled by it.

What part can our religious emotions play in the formation and development of our civilization? Beyond the possibility of a doubt, they played a most important part in it from the very moment that the evolution of the pithecanthrope to a being definitely human had brought to the lips of our remote ancestors the question *why* before they framed the question *how*. It is not my business to put, for example, the man of Chapelle-aux-Saints into his correct place in that obscure series. I recognize a gap between the sub-men of Trinil, whose vocal utterances were probably of the most

¹ Thanks to that remark, an excellent *curé* was inspired to quote me in a work of edification — for which I am duly grateful.

rudimentary sort, and the incipient man, such as the Neanderthal man and the man of Chapelle-aux-Saints, whose lot it may have been to pronounce the first stammering phrases of articulate speech. Prior to that stage of evolution, it seems unlikely that there existed any religious emotion.¹ As I have already explained, its first appearance marked the advent of thinking man. And since the gregarious impulse derives less from intellectual urgings than from the organic needs of self-preservation, as the animals prove (the first manifestation of human consciousness having developed after our ancestors had become gregarious), the religious phenomena must have manifested itself by an explosive emotional outburst in the social group rather than in the individual isolated from his kind by vague peculiarities of reasoning.

When religious emotion (which expressed itself in rites before it expressed itself in dogmatic formulæ) once controlled groups, whether small or great, it followed its great destiny until it attained to the graces of a Fénelon and to the lightning flashes of a Bossuet. This is hardly the place in which to trace the outlines of that history. From the earliest ages religion inevitably seemed the *alpha* and *omega* of all civilizations. Supreme authority was vested in heaven before any one had any idea of seeking it on earth, and as the tardy appearance of a civil power was to incite interminable conflicts, the human race entered at the start upon a succession of tragedies in the very midst of which we are to-day still struggling.

It is quite impossible to reconstruct lost records in any precise detail. However, even in modern times, Asia, traditionally the preserver of primitive states of feeling, has never ceased to offer a picture of religious mentality constantly renewed from ages long past. Why does Gobineau say that 'what we think and the way we think originates in Asia'?² If by that remark the eminent observer means that

¹ I limit myself to terms of comparison the objective reality of which is undeniable, and I do not pretend to go beyond the most modest inductions.

² Gobineau: *Les Religions et les philosophies dans l'Asie centrale*.

thinking man was first formed and developed in warm countries, I do not dispute it. In that sense Asia may be regarded as the mother of those primitive generalizations which preceded all forms of analysis, that is, the first efforts of human intelligence to grasp the unknown.

However, men, wherever they appeared and whenever the conditions were parallel and contemporary, followed in their evolution lines identical in direction, with pauses and even with periods of regression of which the rhythm was determined by the clash of their limitations. Asia, which long since exhausted the whole gamut of subtle dreams, has not yet been able to span the gap which separates imaginative speculation from actual science. The manifestations of religious feeling have consequently always continued singularly active, as was the case in the primitive ages of humanity. We are the gainers, since we can observe at close range the free play of the religious phenomenon in all the ingenuousness of its original manifestations, and since we can thus make ourselves familiar with spectacles in which lapse of time does not allow us to discover historic reality except in the guise of fabulous events.

Read in Gobineau the astonishing history of Babism, an abortive reform of Islam, which in our own day (1854-59) produced in Persia a series of bloody incidents in which Oriental simplicity and self-control turned to frenzy in its reprobation of a corrupt priesthood. In that history you will see vividly depicted how religions are born, and by what verbal forms and by what kinds of acts they drive to battle men whose hearts bleed for human misery. You will better understand in what torments of deed and thought our imaginative doctrines adapt themselves, whether well or ill, to the outbursts of popular emotion provoked by the grotesque contrast between sublime words and inadequate performance.

As happened in the case of Christianity, the chief doctrine of which was the outcome of the interpretations that the Councils superimposed upon evangelical empiricism, the metaphysical formulæ of Babism did not take form un-

til after Babism had died. The prophet, called the 'Bab,' that is, the 'Gate' (access to the Divinity), wrote out his thoughts after the terrible fighting had subsided and during the two years of imprisonment which preceded his execution.¹ I will not linger over Gobineau's exposition. It seems impossible to believe that so much noble blood could have flowed so freely for or against the sacredness of the number 19. There could be no more or no less sense in the matter than there was in the persecutions of our anti-Trinitarians in honor of the number 3. Any imaginative doctrine is as good as the next. The thesis is without importance. The Hindu dies, crying out the word 'Aoum,' since, if he does, he believes he will be saved. Must we then dispute over the quality of a sound?

In all the polemics which Gobineau reports I see nothing more than debates on the demoralization of the Mohammedan priests,² and, to be quite frank, the author, a champion of Christianity, does not handle the Persian Christians too gently. In any case, there appear to have been no other texts than verses from the Koran. Babist doctrine had not as yet taken shape. Nevertheless, there was let loose the most terrible tragedy around the magic name of the 'Bab,' whose principal recommendation, like that of the Nazarene, was that he foretold something different from what actually existed.

I scarcely need describe that enigmatic prophet whom most of the leaders of the movement had never seen, or even sketch the portrait of the admirable heroine ('Consolation of the Eyes') who, like our own Jeanne d'Arc, was duly burned for her fidelity to her God. If we leave out of consideration the setting of exterior circumstances, the action of the inspirer will seem less important, and the lesson to be derived from those noble souls who rushed on nameless tortures for an ideal of superhuman grandeur

¹ He was twenty-six years old when he died.

² The Christian clergy of Europe were able to overcome the prolonged disorders of the Middle Ages far more cheaply. I but note the fact that Islam had men like Avicenna and Averroes.

which they did not even take the trouble to formulate will seem more beautiful.

It is useless to describe the combats of the Babists; useless, even, to describe the capture of their stronghold. A description of the final scene is enough to characterize the movement. The Bab was put into chains, and with his two disciples, was led about the city for a whole day with an iron collar around his neck, that the crowd might heap upon him every kind of insult and every form of abuse. It was announced that when questioned about his doctrines (no one could say just what they were) he had repudiated them. After being clubbed, one of his disciples did actually repudiate him and spat in his face. The Master bore up under every trial, and the two remaining victims were suspended from the ramparts by a rope so that they might be shot in the sight of the delirious mob. The firing squad was composed of Christians because the authorities dared not trust the Mohammedans. The disciple was instantly killed. The Bab received no wound, but the cord by which he was suspended was cut by a bullet. He fell on his feet and took refuge in a neighboring guardhouse, where he was put to the sword. Gobineau tells us that if he had presented himself before the soldiers to attest the miracle, the whole city of *Tabriz* would have been won to his side. Oh, the whims of fate!

The next day the disciple who had denied his master returned to give himself up to the executioners. Nothing more remained to be done except to finish with the prisoners — men, women, and children — who were not afraid to attest their faith. The ministers divided the captives among themselves in order to prove their fidelity to Islam by the refinements of torture which they knew how to invent. Common office-holders had those who fell to their share slashed with knives. The chief equerry had the hands and feet of his victims shackled that he might make them run while being cut to shreds with whips. 'In the streets and bazars of *Teheran*,' writes Gobineau, 'people that day beheld a spectacle which they were never to forget.' Even to-

day when the talk turns on this subject one can feel the horrified wonder which the crowd felt, and which the years have not lessened. They saw come forward between the executioners women and children, with open wounds all over their bodies in which lighted splinters were burning. The victims were dragged along with ropes or were driven under the lash. The women and children advanced singing: 'In truth we come from God, and to God do we return.'

I will not expatiate on the final torture: 'Night fell on a mass of formless flesh. The heads were attached in bunches to the gallows, and the dogs from the outskirts of the town gathered in packs.'

Do not such events, occurring in almost modern times, indicate something more than a popular attachment to an unformulated doctrine of theology? They indicate the supreme aspiration toward an idealism beyond human strength, the aim of which was a moral achievement of conscience, and the evocation of which seems to have been much dreaded by the *de facto* authorities.

Christianity, too quickly distorted by its triumph, sprang into being under identical conditions. After the horrors of the Roman arena came the massacres of heretics by the posterity of the earlier victims. The rôles were too promptly reversed. The last *auto-da-fé* in Spain occurred in 1823. Babism is of yesterday. And, if different and even contradictory religions played an important rôle in the origin and development of civilization, how can we explain the monstrous union of the loftiest thought and the lowest and most shameful exhibition of human barbarity? Considered as a cosmic phenomenon, man should subject himself to his own faculty of analysis, were it only for the more or less dubious prospect of a better future to be realized under the name of civilization.

But are we quite sure that civilized man is so different from the savage? Though the forms of their activities are different and even contrary, there are many resemblances between them, precisely as in the case of the savage when compared with the anthropoid, and, indeed, when compared

with the whole animal series of which he is the product. Oscillations, however wide the arc, remind us of the fundamental bonds from which no one can escape. The worthy man-eating Papuan is awaiting benevolent impulses that are decidedly slow in materializing. For a long time to come there will perhaps be something of the Papuan in 'civilized' man.

I admit that the words which accompany human action, and which seem to determine it, too often offer the chance to disguise from ourselves the temptations to which we promptly yield. We do not realize to what extent our severe judgments of others recoil upon ourselves. It is not certain that the unwritten code of social conventions, so full of pretense and even of hypocrisy, is not the soundest foundation of order in our 'civilization.' Empirically to substitute a social life based on forms rather than on uncompromising fundamentals requires no mean skill. Past and present aspirations meet in us and are preparing a future the lofty ideal of which fills us with splendid illusions in respect to the imperfections of our present conduct. The dream is agile and leaps ahead without effort. Thought, acquired with difficulty, lags behind, heavy and slow from labor. The dream, free of scruple, justifies all the acts of violence committed by the executioners of the Bab, by Caiaphas, by Torquemada. Through the illusory prestige of the past and the construction of an imaginary future, the common characteristic of our different civilizations is to feel, if not to think, in terms of man's primitive misconception of the universe in order to escape the call of importunate realities.

In this matter, purely religious activity counts especially because of a spontaneous tendency of the human organism to decree the universe instead of investigating it. But the day inevitably came when mental evolution showed itself in that urgent demand for knowledge which only experimental science could satisfy. Up to that time we remained in a confused state of undisciplined intelligence, awaiting a progressive effort of coördinated evolution. Suppose even that 'Revelation,' as it declares, had furnished an absolutely

adequate answer to the first questions of mankind ; the word 'civilization' would have no meaning. If man had known from the start all that he could and ought to know — experience coinciding at every point with doctrine — then immobility would have taken the place of evolution. All human history would have been changed, if not, indeed, reduced to nothing.

The sanguinary episode of Babism, like that of Christianity, naturally takes its historic place among the developments of religious emotion considered as a factor of 'civilization.' To what savage deeds might not the very victims of Babism have let themselves go in their turn, had they marched behind a Mahomet? For Christianity to risk boasting of its gentleness, it must be singularly forgetful of its own past history. I do not intend to put any particular religion on its trial here. If civilization is indeed the result of increased mansuetude, facts prove the brutal attitude of the absolutist spirit toward that universal tolerance which is required for the hard task of laboriously civilized life.

'I understand you perfectly,' the mystic will say, 'but there is religion and religion.' Whereupon the Christian will hasten to explain that it is his particular God who has willed 'civilization.' Alas! Why has he not brought about its realization? Ozanam, in his 'History of Civilization in the Fifth Century,' undertakes to prove that his Christianity is civilization itself, as if all preceding civilizations did not count. Did not Gobineau, a professed Christian, himself declare that Islamism is only a branch of Christian culture, and that there is no nobler faith? So the Greek of the ages in which it is not certain that a single Greek was a true believer, spoke of Hellenism. The same thing is true of the Brahmin of the time before Sakya Muni. So it is in every case. Can the truth be that if we search the innermost soul of man, we shall find as many religions as there are individuals? From the common doctrine, which has merely the value of conventional phraseology, each man picks and chooses according to his fancy whatever is suitable for the government of his own life, that is, such of it as he

thinks he *can put into verbal practice*. Of that quintessence of empiricism and idealism, blended of intelligence and will in variable proportions, every one composes the deeds and words of his days.

The moral framework of religious doctrine will be none the less publicly established on the plea that it is a common support, but for the intimate comfort of such relative beings as ourselves, a great part of the divine absolute will have to be pared away. In no such way can come the impulse toward civilization, for that impulse leads us to exteriorize all the repercussions that scientific knowledge awakes in our organisms in order to compose from them the best, most beautiful, and noblest elements of an existence in which the future is perpetually taking form. Religion is an attempt to give personality to the ideal, which is quivering and bending under the assault of that scientific knowledge which is the basis of the energies of experimental civilization, that is, social life in process of perfecting itself. So far as intellectual culture, together with the conflicts between old and new emotions, permits the contradictory phenomena of man can long survive in the shape of the joys and sorrows which are the two poles of human life.

General evolution, compounded of particular evolutions, creates our actual civilization as much through the interdependence of individual evolutions as through their contrariety. Until the day of experimental science, metaphysics and theology succeeded in keeping in their hands the official key to all the problems. The moment came, nevertheless, to ask whether the multiple states of 'variable man' did not show successive steps in the advance through which coördinate forms were developed. That is the so-called evolutionary view, according to the terms of which there exists in the world nothing but a continuous flow of activities, the transient aspects of which we term phenomena — mutually implying and explaining one another.

Instead, then, of asking ourselves whether such or such a people can or cannot be included in the magic category of what we call 'civilization'; instead of wondering over the

incongruous mixtures of idealism and barbarous atavism that characterize a given people at a given period of their history, all we need do is to note the current of universal evolution that rhythmically carries the universe forward, and along with it transitory man with his conflicting hereditary primitiveness and his more or less scientifically based idealogical aspirations.

Civilization represents an organic evolution of socialized man; that is the whole truth of the matter summed up in a formula against which no metaphysics can prevail. Just as the Bonalds and the Guizots have lost themselves in the wastes of obsolete interpretations in an attempt to reconcile with the Biblical legends parts of modern science of which they could not shake themselves free, so have we been forced by what we have established of the human phenomenon to recognize the incessant evolution of the man of every period.

On the matter of organic evolution, metaphysical clerics are silent; they have no explanation to offer. Not that they are especially embarrassed by the phenomena attending any particular phase of evolution, as, for example, the development of the visual organ, for they dodge the difficulty by the trick of a finalism which is within the comprehension of any degree of ignorance.¹ It is the evolution of the brain which they dread to face, for in order to meet the needs of the cogitative function they had created the entity, soul, which, being unchanging and unchangeable, could not be reconciled with the fact of mutation. On the other hand, when man's mental predominance had set him on the path toward 'civilization,' *psychic* evolution, with its inevitable correlations,² became the real key to his *positive* evolution. History, however incoherent it has been and still too often

¹ From the sensitiveness of the skin to light to the stain of pigment from which evolution produced the organ of sight, indefinable transitions indicate the formation of the sensitized surface of the retina on which the world impresses its image, and which produced emotion and thought in their earliest forms.

² Thus, when man was learning to stand erect, for example, the effort of a growing intellect should have notably aided the new adjustment which was taking place.

is, shows us man rising throughout the course of the ages, along evolutionary lines determined by the conscious endeavors of verified knowledge.

We sum up that history when we say that man passes, or tends to pass, from primitive savagery to a state in which more or less happily coördinated legal codes are the bases of a social order intended eventually to achieve orderly government, except in so far as it may suffer from the counter-offensives of an unbridled selfishness originating in our primitive state. Progress which rhythmically alternates with regression constitutes what we proudly name 'civilization,' a word by which we designate those high, but not firmly based, aspirations from which simultaneously flow the victories and the defeats which we disguise under specious words. If we bear in mind that at the start the task was to advance from cannibalism and slavery (still surviving in certain countries) to the gentle benevolence of Buddha, Christ, and Saint Francis of Assisi, we realize that notable results have been obtained. In our wars we kill a much greater number of our kind than we killed in former days, but we no longer kill them in order to eat them, nor do we capture them in order to sell them. Slavery in its crudest form was abolished in America, a land of Christian civilization, at the cost of a frightful civil war that for four years caused blood to flow in torrents.

Meanwhile, we are still far from the standard of Buddha and of that very Christ whom we glorify, without, however, progressing from words to deeds except as a matter of form. What conclusion can we draw? The conclusion is that gregarious evolution, described as civilized life, advances us but gradually along the difficult path toward a moderate social achievement, our attainment of which seems still immeasurably remote. After innumerable centuries of haphazard wandering we have undoubtedly made some intellectual progress. It is no less certain that the rhythm of our progress is compensated with a rhythm of regression in which the old selfish and atavistic impulses recover their predominance. Alas, the ways of multiplying evil remain

more effective than the ways of diffusing good! Let us not be astonished that the law of man is to misuse and to extend that misuse in every direction before he can learn to hold himself in check and to govern himself.

Too often the law of the easiest way creates a wide gap between our intimate thought and the words which pretend to express it. The ever-ready flow of intemperate language is too favorable to every weakness of character in which the use and abuse of selfish disguises is implicit. The common varnish of social hypocrisy as a permanent institution results rather in each person's deceiving himself than in his deceiving others. Consider the gap which under the pomp of witching words that give every verbal satisfaction to men of mediocre conscience lies between precept and accomplishment. They are the men by whom the massed opinion of the inert crowd so sharply satirized by Ibsen¹ is imposed on the unfortunate person who would have conduct conform to speech. And on this attitude is placed the seal of finality by the tacit assent of those who wear smiling masks to disguise their selfish interests, or who use the tinsel of words to defeat dimly seen realities. The civilization of convention has the advantage over reality, for it can be more noisily proclaimed. Thus we see that the lies of professional falsifiers have, perhaps, a less baneful effect than the verbal distortions of truthful men who are satisfied with a varnish of truth.

Between the exaggerated courtesy so universally taught (a circumstance I dare not complain of) and those displays of enthusiasm or of censure in which we give our loquacity full vent, there is a flood of pretense — prosaic or lyrical — that as a whole reacts on the public mind to the detriment of the deep aspiration toward intellectual honesty. With an ironic smile the Muse of Hesiod announced in her day that she knew how to adorn falsehood with plausibility, and that when she would, she could even tell the truth. In our day, a delightful comedy by Labiche, '*Le Misanthrope et l'Auvergnat*,' amusingly portrays what difficulties are to be met

¹ *An Enemy of the People.*

in a life from which falsehood is banished. Enlarge the stage, and perhaps you will ask yourself what would be left of our civilization if we deliberately eliminated all dissimulation from our speech.

Alas, the path from social duplicity to definite rascality is slippery smooth. It is not superfluous to point out its perils. We shall not alter human nature. In the torpidity of our subconsciousness, the readiness of words to misrepresent thought makes it possible to give a favorable aspect to our civilization. Nevertheless, by cultivating the hypocrisies which come from the temptation to follow the easiest path, that trickiness of words is fundamentally prejudicial to the proper development of human society. Perhaps pointing out the evil is enough to tempt the elect to rise to a higher plane through an ever increasing spirit of justice and of sincerity. A fragile hope, to be sure, but one which I am unwilling to abandon!

No doubt we are continually saying that no one is deceived. I might reply that when there is reciprocity, every one deceives every one else, since each one of us is unconsciously led to deceive himself before deceiving others. Right there, indeed, is the worst element in the situation. We soon become completely indifferent to fundamental truth whenever our immediate self-interest is at stake. Let us take, for example, that unbounded field of imagination in which through the assent of the majority theological hypothesis crystallizes into dogma. What professions of faith, obviously due to the spirit of compliance, hasten to respond to the call of those social interests which become grouped around an organized cult! The excuse for the lie is ready: 'We must act like all the world.'¹ We assent without carefully questioning whether we hear any important protest from our consciences. We renounce conscience in advance. And thus we find ourselves sinning against ourselves before we have sinned against others.

¹ Why, indeed, should any one act otherwise than he thinks because others think, or say that they think, differently from him? The question is generally transformed into a bare affirmation — and with reason.

Having begun by being ignorant, we based the structure of knowledge on misconceptions which successive efforts had great difficulty in correcting. What chance had we of hitting upon the correct explanation? How was our effort to be judged by the public at large? The more effort the labor required, the more the majority in their lazy ignorance turned from it. The strength of the Church against Galileo came from a deaf and blind public which had no desire to know. What did they ask of the man of science? A lie. Under the threat of the flames he consented to abjure. For a while the lie triumphed. Well, that famous tragedy of which men speak as little as they can because there flashes from it the lightning of truth is precisely the drama that is acted in the depths of our consciences at every moment when a question of dogma is raised. Too many persons are ignorant. Too many persons do not care to know. From sharing the errors of the crowd no injury follows — quite the contrary. Truth seems a trap when the authorities are its enemies. Could the invitation to make a habit of profitable pretense be clearer?

Whatever form the human drama takes, it cannot be diverted from its course. From the weak crowd that arrogates to itself the right to rule the universe, little bothered by the contradictions that it meets, what can we expect in the way of the development of social thought in the field of ideal civilization? Our posterity may find out. For many reasons, I shall not take the risk of prophesying. I have already said that by the word 'crowd' I mean the men of all degrees of culture and of rank who, as is the case with the majority, are content to share the mental, and especially the emotional, state of the less developed. Wherever they come from, whoever they are, how can they help falling a prey to the common verbal tricks into the power of which they have given themselves? Do not many so delight in loudly claiming every high-sounding virtue that they have no time in which to practice any of them?

I wonder whether we appreciate how severely our fine verbal civilization suffers in spite of our sometimes excellent

intentions. We intend the good; we make a parade of the best, yet, apparently with equal indifference, we do what is wrong and sometimes even what is right. Let us not be surprised that people cite indifferently the merits and the defects of our civilization which makes it simultaneously worthy of praise and of blame.

What a pity it is that merely singing the praises of this civilization of ours will not make it come up to the proclaimed standard, especially at a time when we see it rhythmically divided between peace and war, both of which in turn we laud with the same enthusiasm — peace that every day increases our means of destruction, war that never tires of celebrating the satisfaction of our fury. Our civilization is a confused medley of correct and distorted knowledge, of bold error and timid waverings between doubt and truth, of expectations disappointed or surpassed, of will and of weakness, of domination and of cowardice, of diligent reason and disordered passion, with no other result than a general agreement of incompetent minds in commonplace solutions which prompt us simultaneously to boast our greatness and to live basely. Such is the miracle of our 'civilization,' to which we are led by that constant struggle between good and evil which was inconsistently instituted by that Power of absolute good who was unable to make of man anything except a relative creature. Is not the strong and the weak point in all forms of organized life the fact that they promise more than they can give? Is not life a cycle of perpetual hopes and of perpetual disappointments which we must change into hopes again, only soon to fall once more and perhaps once more to find our feet? And, on the other hand, how dull life would be were there no chance to make mistakes!

The nature of things saves us from that risk in spite of the puerile dogmatists who claim that they know the secret of the universe intuitively, and even that they can impart it to us, whether we will or not. Luckily their 'Revelation,' which they proclaim as infallible, is offset by a science which, though 'fallible,' is yet reasonably accurate, and

which abundantly contributes to the progress of our civilized evolution. Without it, we should still be at the stage represented by the Nicean Council. After the trial of Galileo we were permitted to proceed, independently of dogma, from rectified misconception to verified observation and to assimilate relative truths which, with the aid of a logical empiricism, can bring out what is actually of value in past civilization. The only requirement is that the directing influence of a superior emotional nature, born of organic effort itself, be added to the activities of knowledge. Such a combination will lift us above the selfish concentration of our Ego to the refinements of mutual helpfulness, whereas 'Revelation' aspires to lead our selfishness from a purely verbal charity to the final triumph of a paradisiacal egoism — the determining principle of all the actions of a distorted life.

We seek ideal beauty, justice, happiness, that is, something beyond our short-lived relativity. It is always easy to promise us all of those things in another life — a due-date that can never fall. Children who cry for the moon stop crying when they see that no one will give it to them. Then they ask for something easier which they have a chance of getting. Grown-up people are much the same. They demand the absolute, and *in theory* they get it if they are willing to postpone its actual joys indefinitely, which amounts to never obtaining them at all. Instead of becoming lost in expectation of the miraculous, the man capable of putting the implements of knowledge to use can coördinate sums of relative knowledge that in proportion as they are realized express acting and thinking man, which is the supreme object of our civilization.

Has 'free man,' with his inevitable mistakes, succeeded better in the enterprise of building up a civilization than did the spokesman of an ideology of the absolute who placed us under the crushing yoke of celestial or earthly autocracies? With all due conservatism, I believe that we can affirm it, although the pride of man when he discovered that he could help to mould his own fate carried him to the

point of too often confounding his brief relativity with the universal authority of a Cosmos, deified for his advantage.

And yet the most pompous verbal labels will not confer on man the privilege of a durable personality if he who calls himself free is not in a position to live his liberty. Do not institutions based on identical formulæ frequently harmonize with very different manners and mental states?

The very obvious fact is that institutions are valuable according to what they accomplish; that is, in proportion to the moral and intellectual capacity of the individuals who have framed them. The fact seems so natural that it is astonishing that it needs to be stated. But so many people — and people of by no means mediocre intelligence — have let themselves be deceived that we must recognize the mistake which led people in good faith to think that human progress could be accomplished by decree.

On the other hand, in the field of verbal civilization — which I do not wish to decry, since it has contributed to the formation of a high ideology — notable results have been attained. Merely verbal civilization was the solace of those ages which failed to perform what they promised; it is the serene refuge of all great minds and the happy phantom the illusion of which soothes those weak-minded folk who must have hope at any cost. Out of intellectual approximations of civilization based on doctrine and vitalized by efforts that are not always barren, people create what is finest in their lives, on condition, however, that there shall be atavistic returns to the violence of ancient savagery. Atavism demands that rhythm, because in the depths of our nature the inheritance of innate characteristics necessarily takes precedence over the inheritance of acquired characteristics.

We must, however, adapt ourselves to that state of affairs, since we cannot change the laws of the elements. Hence I take the liberty of suggesting to my fellowmen that they make up their minds so to adapt themselves, as Voltaire had plainly done when he wrote: 'The more men think, the

less wretched will they be.' Have we not found that to think is to recognize the interrelations of things? Once we have recognized cosmic relations, what can we do but conform to them? Voltaire was prudent enough not to say that we should thus attain happiness. He merely pointed out a chance of being less miserable. If I dared go a step beyond Voltaire, I should suggest that we may aspire to something better, and that, through orderly emotional progress, we can substitute for the noisy vanity of wasted lives the pride of a life fortunately spent in a gleam of consciousness that as it passes justifies our moment in eternity.

To adapt ourselves to what experience of the world has taught us, that is, to our destiny, with the intention of bringing to it the collaboration of our solitary effort is indeed a task which requires more sensibility and will-power than is given to the common run of men. The general sense of life will be determined either in conformity with the laws of the universe which govern the lot of mankind or in contradiction to them in accordance with the tendencies and degrees of personal evolution. Nothing is accomplished by exalting man to the heights or by plunging him into the depths, since for each one of us the problem is simply to live in harmony with the workings of his organs, which, being without consciousness, permit us to have the happy sensation of 'free will,' the mother of personality.

Primitive fatalism with which the mind of Asia was saturated knew nothing of the evolutionary formation of a consciousness in the fundamental determinism of which is implied the struggle toward personality. Before as well as after the advent of generalized knowledge, imaginative empiricism sought the solution of the human enigma in that passionate desire for liberation. Thence came the glorification of the 'soul,' something halfway between organism and entity, which would compensate us for inevitable earthly woes with everlasting felicity. 'We emphasize nothing but our misfortunes,' Vauvenargues says wisely, as if the good that we are able to make for ourselves through our own efforts were no more than our due. Who-

ever is brave enough to take pride in a destiny in which it is his signal good fortune to collaborate will willingly accept this half-real 'creation of himself by which he partially substitutes himself for the ancient Divinity.' He will pass, as man's gods themselves have passed. Ready for life, ready for death, he will show himself worthy to live and for that very reason will have lived to the full.

Sainte-Beuve regrets that in the correspondence of their old age Saint-Évremond and Ninon did not feel the need of exchanging illusions. The remark does not lack savor. At the same time, why should they have thought of doing so if, all things considered, they were wisely content with a life that ruled imagination instead of surrendering to it. I should consider the omission rather as the sign of the maturity of two lofty minds. Doubtless there is, and can be, no human being who is not now and again under the influence of illusion, and who does not sometimes find it the most precious thing in life. Dislodged by observation, phantoms too often merely shift their position. If minds for whom the pleasures of the intelligence perfected with the glow of emotion are sufficient, why quarrel with them over the quality of a delight inferior to none? To live by imagination will always be easier than to live by reality. Pascal or Fénelon will none the less have their place in the sun, and no one will begrudge it to them.

It is a great mistake to wish for uniformity of function in different organisms. Scientific knowledge exacts labors the remuneration for which falls due at no certain date. Happy is he who can be content with it. Imagination anticipates the course of future evolution, and far from finding fault with it, I gladly welcome it, if, aided by experience, it makes our progress through life more pleasant. The illusions evoked by the twists and turns of objective fact can vary limitlessly. I include Saint-Évremond and Ninon among the few historic personages who, along the rough path of life, were not willing to lie either to themselves or to others. On the other hand, it seems to me that too many persons are content with illusions arranged in sequence in order to

attain sham 'convictions,' practically useful, but indicative of little elevation of mind.¹

If the general idea of a developing civilized life forces us to go back to the obscure evolution of individual sensibility, every ethnic group necessarily contributed to it its own particular characteristics. As a matter of fact, the entire concourse of varying types of knowledge and of emotion contributed their constituents to the common task of bringing about an increase of intelligence — something that must not be confounded with our industrial mechanism, which merely supplies the means. It is one thing to build a locomotive, and quite another to know where we want to go.

¹ Thus Napoleon at Saint Helena after his dethronement virtually admitted that he merely pretended to share the popular beliefs in order to use them as a means of domination. According to Gourgaud's *Journal*, which any one who wishes to know the real thoughts of Napoleon on the question of religion must read, the great destroyer of men, in whose eyes the administrative organization of dogma seemed such a powerful instrument of government, had too closely considered humanity to let himself be caught with the bait of the words to which in public he paid such prodigal homage. He referred to the matter at every turn in his conversations at Saint Helena. 'When, while hunting, I had the stags dressed in my presence, I saw clearly that there was no difference between them and men. Man is merely a more perfect being than the dogs or the trees, and one that has a better life. The plant is the first link in the chain of which man is the last. . . . Monge, Berthollet and Laplace are true atheists. I believe that man sprang from the soil, was warmed by the sun, and combined with the electric fluid. What are animals; an ox, for example, if not organic matter? Thus, when we see that our makeup differs little from theirs, should we not believe that man is no more than better organized matter of which he represents the almost perfect state? Some day, perhaps there will appear beings in whom matter will be brought still nearer perfection. Where is the soul of an infant, or of an idiot?'

Moreover, the diversity of religions seemed to the fallen ruler an irresistible argument against Revelation. 'I should believe in a religion if it had existed from the beginning of the world.' And this is his bold conclusion: 'There is no such thing as a willing atheist.'

It took Waterloo to bring the man who had been crowned at Nôtre-Dame face to face with himself and to make him admit his secret thoughts about his own methods of government. He refused to take a chaplain to Saint Helena, and the Catholic babies that were born to the people who accompanied him were baptized by a Protestant minister. I call attention to these facts because they teach a positive lesson on the too common dishonesty of the great managers of men, with this difference, nevertheless: many of them would not have been found big enough to risk such an avowal, even had they not been the first dupes of their own preachments.

Embarrassed by every sort of competing interest in peace and in war, and with nothing to show as results from day to day except alternating attacks of fever and of apathy, the phenomenon of an evolutionary social mentality is none the less one of the noblest manifestations of a humanity in travail of the future. To what extent the initiative of authority on the one hand and deliberating bodies with their usual accompaniment of success or failure on the other, contribute to it forms a serious subject for debate. Everything has probably been said that can be said on such matters as the special composition of public authority and the guaranties of the rights of the individual, but the results have not always matched the hope that has never been lacking.

Perhaps the wisest course is to have faith in the average general equilibrium that results from conflicting abuses. The despotism and the anarchy that follow each other in rhythmical alternation are alike in more than one aspect. If some day we strike a golden mean between them, we shall have reason to rejoice. 'Government by the classes' has not always been especially successful. I admire the Convention no more than I admire the 'Undiscoverable Chamber,' and I even distrust the government of 'thinkers' when I remember that Auguste Comte, constituting himself intellectual dictator, began by dogmatically interdicting those experimental studies from which the finest discoveries of modern science were to issue. Religions, seeking uniformity, have produced nothing but struggles over heresy. Finally, 'democracy,' long the supreme hope of badly governed peoples, provoked by its uncontrollable chatter and by its too obvious lowering of character the violent reactions embodied in Sovietism and in Fascism — not to mention other forms of government which may be in the making.

As a result of disappointment after disappointment, the Athenians were led to solve the problem by leaving the task of government to chance. They chose their magistrates by lot and found themselves no better and no worse off than before. I wonder whether as a result of general mental pro-

gress we are justified in expecting the average man (in other words, the majority) to produce any better results in time of stress. Let us not regulate our patience by the eagerness of our aspirations.

The truth is that we have never been governed except by interested oligarchies under different names and dressed up in ideological terminology. Of the strength and the weaknesses of democratic oligarchies much might be said. In the two thousand years since Athens I cannot see that they have greatly changed. It is encouraging to think that with fair luck civilization may find highways where we can fasten hopeful signs on the milestones of eternity.

Whatever happens, the conflicts between majorities and minorities will remain the marrow of human history. 'The weak are always at war with the stronger; that is the source of eternal hatreds.' Thus through the mouth of Creon Euripides speaks, for every age that has been or will be. Even to-day we should congratulate ourselves that 'civilized life' has mitigated the opposition between the strong and the weak by successive daily adaptations to unbending fate. Let us at least recognize that evolutionary civilization will be achieved by our own effort, and that if we are to improve the lot of the community, we must first of all be in a fit state to govern our individual selves. Empiricism needs ideals. Idealism, resentful of any check, must learn self-control. We are poor human creatures proud of our relativity, yet suffering from it.

UNIVERSAL COMPETITION

Every social act is the result of composite forces — an association of interests in which the individual and society do not support each other and do not help each other except as they push against each other. Each must give up something of his independence ¹ if he is to assure himself of the coöperation of society in a common purpose. Permanent social cohesion is essential to any form of progress. In

¹ The sacrifice is less than it seems. Of what use is that 'independence' under the resistless action of the cosmic phenomena which enslaves us?

animal groups unconscious tropism has remained too powerful a factor for the conscious activity of individual psychism to withstand the irresistible urge of the majority towards a common purpose.¹ In the case of human beings, the innumerable goals of a complex psychism produce groups animated by different purposes. Hence arises the need of a strong regulating authority, which inevitably opposes the errors, if not too often the current, — I do not say the normal, — exercise of individual enterprise.

Universal competition through the composition of its forces is nevertheless the law of all the individuations of the universe. From competition results the phenomenon of natural selection, which favors the strongest, and the importance of which Darwin so strikingly pointed out. The whole question is to know whether we cannot offset combinations of prejudicial forces with advantageous ones. At that goal individual culture must aim. It should strive to detach us from our own individual interests to the extent necessary to enable us so to combine social forces that the weak may enjoy the larger life to which the fact that they have been born entitles them.

I cannot be expected to paint the picture of the struggle for life. The detail would be too frightful. From the primary organisms to finished man, war without quarter has never ceased, and the result is an indescribable accumulation of cruelties which make of this planet an immense field of carnage, and there seems to be no chance that the miracle of a gleam of peace will suspend the slaughter even for a moment. Such is the world which, we are told, we should consider as the master-piece of an all-powerful Providence compounded of love and kindness! And when we have discovered that the activities of the universe are wholly devoid of any human charity, and when, finally, the intimation has reached us that if our lot is to be improved, the improvement must come from ourselves, we have talked loud and long of unselfishness, but have postponed as long

¹ This is true even in temporary groups, such as those formed during migration or in the transient association of larks or of sparrows in winter.

as possible all practice of it. The church never stops preaching self-denial, and endless gifts are made to religious organizations in the selfish expectation of personal salvation. But in the balance sheet of our civilized life to how much does disinterested help from one man to another, regardless of all publicity, amount?

As bad (or good) luck would have it, familiarity with the 'providential' carnage to which our organic structure condemns us has from childhood¹ made us insensible to its horror. We describe the wolf as ferocious in its dealings with the sheep. The wolf is hungry, and so are we. Do we not make exactly the same use of the sheep after having skillfully dressed it? The slope from human insensibility to cruelty is slippery smooth. The first victim was the beast, the next was the man brutalized by slavery. How much harder it is to raise an asylum of human kindness, built of emotions dulled by contact with the asperities of life and resting on the cosmic foundation of everlasting bloodshed, than to expect of the Cosmos, personified as a divinity, the benevolence which we should look for in ourselves rather than vainly ask it of deaf gods!

The path that we must follow is desperately arduous; our means are inadequate; our ardor is too easily discouraged by every appeal of our immediate interests, which, we think, must be served at any price. Facile evasions are ubiquitous. Above all, blind empiricism requires the maintenance of the *status quo*, and inherited egoism strengthens interested altruism in defiance of every ideological suggestion. However, there is the family, the human family, the first group around the hearthstone, in which there appeared a potent sensibility. We know that in animal families there exists every degree of sensibility in the relations of the sexes and in the care of the young. And yet there are people who can find in this complete confusion the result of benevolent design!

The evolution of emotional sensibility led the human couple to various family developments which progressively spread to neighboring families, and to tribes through the

¹ 'This age is pitiless.'

agency of matrimonial unions that form altruistic bonds to which the most brutal man must sooner or later yield. No doubt it took long to pass from this elementary altruism to an active love of mankind and to noble effusions of universal charity. But time is of no consequence in the activities of the Cosmos. How long did it take the storms and tides of the ocean to reduce to fine sand the rocks and the marine deposits?

I shall not try to estimate the centuries which passed during the insensible evolution from spontaneous family life to the aspiration for mutual helpfulness, now and then supported by a fortuitous reciprocity. The obscure sense of solidarity was doubtless illuminated little by little by the radiance of a human sentiment made manifest in coördinate altruism and in impulses of devotion, already notable among animals — as in the case of the dog as we know him.

The day on which the desire to sacrifice ourselves for others thrilled our emotional depths was the day from which we can date the origin of 'civilization,' that is, an ameliorization of manners which was to remove us farther and farther from the primitive savagery from which ever-improving humanity issued. We find devotion in the brute that defends its young, or even one of its companions in life. The man who at a time when pity for all life was by no means general could give himself to his human fellows had no peer. His advent marked the beginning of civilization. And since in his search for a better way to employ his life he could not help others without at the same time aiding himself, there developed a rudimentary form of coöperation, the idealism of which helped us to bear with dignity the trials of our lot.

It was a great step forward to have conceived the idea of civilized life and still more to celebrate it and to sing it. It is hard actually to attain even the least part of it. When we began to talk about it, a vague resolve awoke in us to realize it in action; but we very quickly excused ourselves on the ground that the task was done. Our more or less openly avowed selfish interests found too easy a profit in pretense not to take advantage of weaknesses of which we were not

at all or but dimly conscious. Thus there came to flourish in the world a morality of precepts of the most striking kind, as contrasted with the ordinary actions of private and public life which disavowed them. It was, indeed, the votaries of the religion of love who but yesterday, as a matter of dogma, had been burning their fellows because of their heresy, that is, because they differed from them in doctrine. Indeed, it was the 'children of Christ' who piously presided over the tortures of the judicial rack or of the stake. It was, moreover, the 'children of Christ' who but yesterday sanctioned the cruelties of slavery practiced by a Christian people of a refined intellectual and emotional culture.¹ In France the last serfs were the serfs of the monks on Mount Jura whom Voltaire denounced. Dogmatically imbued with the teaching of the Church in its cruelest atavistic form, the leaders of the French Revolution, seeking the reign of happiness on earth, could find nothing better to do than to replace the stake with a permanent guillotine.² Do not the sermons preached by men in historic times in favor of human charity result principally in religious bargains made with an eye to a selfish reward after death? Does not the man of every period of progressive 'civilization' aggravate the increasing savagery of war in which the most obvious aspect of social progress is the measureless increase of bloodshed?

THE INDIVIDUAL AND THE SOCIAL COMPLEX

It may be said that there are as many 'civilizations' as there are peoples, for each social group lives, so far as it can,

¹ When I arrived in the United States after the capture of Richmond I was surprised to find in the Southern States a remarkably refined society in which the selfish prejudice in favor of slavery was mingled with the most delicate sentiment. Almost every evening I found on my table some work in which it was proved that slavery was sanctioned in the Bible. The proof of that was not hard to furnish.

² The romantic sense usually given to the word 'revolution' makes the riotous makers of an anticipated new society look like super-human prodigies. They are, however, no more than common examples of contemporary humanity hidden under pompous names. The bloody Convention was composed almost wholly of men who were afraid. They belonged to a type that has not disappeared.

in accordance with the characteristic thought and action out of which it constructs its theory of life. However, at the summons of a verbal ideal twisted to suit the common weakness the general traits of human character, whether amid the violence of war or amid the reconciliations of peace, produce a common stock of mutually reacting developments. For that reason we should note the great governing lines of human evolution with its inevitable delay in the transition from words to action.

In that connection, the exchange of thought by whatever name it may be called — conversation, discussion, reading, preaching, teaching — seems the most characteristic phenomenon in the evolution of social man. Each one of us keeps constantly and industriously at it according to the mould of his mind. And if the quality of his procedure is not the best, the total effect is none the less powerful, as much because of the daily multiplication of contacts as because of the slowly strengthening virtue of a manifestation of average utilitarian altruism. It is even possible that this is the touchstone of civilization.

What would civilization be if we did not carry and form it in ourselves? What should we do if we were not able to communicate it from man to man with a view to a general evolution — a complex of the evolution of individuals? I do not believe that there is any phenomenon in the universe more remarkable than this interaction of minds, resulting in the reciprocal interchange of new decisions and of the activities that follow them. It is nothing less than a synthesis of coördinate evolutions, the achievements of which history permits us to follow. Whatever the doctrine, the satisfaction of mutual helpfulness would be the finest privilege of man if he did not too often abuse it in the attempt to constrain the convictions of others. Even so, it is a fine thing when emotional states meet and fuse.

The sentiments of animals are, generally speaking, in conflict — a conflict that is settled by the law of the strongest. Human beings, dispersive in sentiment, aspire to mental conformity, which can be obtained (in part) only at the

price of an extreme effort of will-power. As star acts on star at enormous distances, and as the magnet attracts iron, so the mental states of human beings everywhere and always call to one another in the hope of realizing a harmony which they never wholly attain. By the mere emission of sounds which have a conventional meaning, the individual acts on the crowd and the crowd on the individual for the regulation of social activities whether in the interests of harmony or of apposition. The original frame of mind of each and all of us is a complex of hasty interpretations and inherited predilections to which in spite of the fact that they are contradicted by experience we stubbornly cling in the hope that, with luck, there may result a provisional equilibrium between knowledge and misconception—an equilibrium, that is, of so-called 'common sense.' Hence it is not surprising that in such a state of mental development 'illusion' should have been a help not to be disdained.

The ancient preëminence of military autocracy, spreading fear on all sides by force of arms, had the decisive advantage of cutting short all debate. It imposed its rule by means of oligarchical compacts of mutual aid in periods of popular docility in which the simplest problems of social justice were decreed to be anarchistic. But we are bold enough to assert that we have reached the period of liberation. It is, to be sure, only a verbal liberation which perhaps will some day become a liberation in fact. That true liberation may be the great revolution which will transform governed into self-governing man. Up to the present time, it has been a fine topic of discourse, but results have been wholly inadequate.

Voluntary or not, slavery cannot serve as a school of liberty. La Boétie declares that man lets himself be enslaved because, ignorant of his own powers, he cannot muster the energy to resist.¹ Man had not attained self-knowledge at a time when Montaigne was still trying to understand him-

¹ Oddly, no one has ever tried to answer the question of 'voluntary slavery' raised by La Boétie. It has always been regarded as a bit of rhetoric. To-day we can really go a bit farther than that.

self. And when some day he begins to realize his power — since the government of man by man demands that he comprehend both himself and others — he will be required to unite two faculties that seem mutually exclusive — the art of yielding (to what extent?) to the exigencies of the stupid, and the art of rejecting uncertain chances of success, and of living from day to day with the amount of equivocation made requisite by the psychological confusion of those who, with or without a reason, must make the decisive choice.

I am adventuring along dangerous paths, but I am the partisan of no form of government, and criticism seems to me the best proof of zeal in the service of an idea. Man will not again submit to the yoke of his former masters. No more doubt is possible on that point. Can we say without base flattery that he is capable of self-government? The question cannot be decided so simply as that. Great peoples have attempted the adventure; and they have marked the path of the future by the very mistakes which caused their failure. Far from discouraging us, the example leads us to profit by the lessons of every period. Such noble efforts cannot be wasted. Is not harking back to the origin of our weakness in order to find out a remedy for it by all odds the best way to serve humanity?

How can man, through the development of his thought within the limits of his knowledge of the universe and of himself, act on his contemporaries and on posterity in a way to bring to a noble realization the too easily discounted social ideals of the future? There lies the whole question of human evolution, the organic action of which can be powerfully accelerated by the reactions of scientific knowledge on past and present experience. Speech, writing, printing, all the facilities for mental communication, have singularly clarified our first notions of the problem and might perhaps even have solved it, were the meeting of minds enough to drive us into systematic action. That any appearance of rational order can result from the frightful hubbub of agreement and disagreement that current emotion vivifies and

sharpens is something that may well lead us to show more surprise at the good achieved than at the evil let loose.

Autocracy is easy to exercise; it is free of control; it is not responsible to the public, and it need not worry about inconsistent results. Democracy, which asserts that it provides for the social development of man, would perhaps not fail of success if it did not require men expressly fitted to care for its pretenses as well as for its realities. It would perhaps be enough for democracy to systematize with the aid of experience our experimentally tested investigations into ideology, while the happy evolution of men of cultivated intelligence would lead governors and governed alike to acquire a flexible skill in the art of getting along together. Until that time comes, I do not hesitate to maintain that we shall be the prey of noble or base oligarchies, by whatever name they may call themselves.

The brevity of our life makes us accuse evolution of being slow. If every one were to regard his duty toward others as one form of his duty toward himself, the social evolution of civilization would be wonderfully accelerated. We have not yet reached that point. Perhaps we shall attain it, since we can already appreciate that the effort is not beyond our abilities. What we distinguish most clearly amid the confusion of our lives is that character and intelligence are not suitably apportioned. This evil, continuing from primitive ages, will perhaps find its remedy in the progress of general culture, which will lead the impassive masses to take bold but reasoned action, and the so-called men of action to subject their minds to intellectual discipline. The problem has existed ever since social groups originated. I promise no earthly Paradise, and no one should reproach me for not doing so.

Too many persons have applied themselves to distorting history in order to make it suit their own fancies. The effect has been that for centuries we have remained in complete ignorance of our planetary condition. The time seems finally to have come when we can abandon a ridiculous optimism, required by our puerile need of a prospective felicity at no

matter what cost. It is time to lift the veil of Isis and to gaze fearlessly at the austere truth. It is not true that we must inevitably choose between an absolute good and an absolute evil that lie in wait for us. The morbid abdication of the pessimist is no less foreign to the nature of things than the optimist's deification of our tame humanity. In the system of cosmic coördination everything is adjusted and must be adjusted. But that adjustment cannot be made to conform to the shifting sensibilities of the individual. And if man is foolish enough to demand a universe different from that from which he issues, the Cosmos will not heed his vain outcries. It proceeds under other laws of space and time than those which govern us. It is only too easy to explain how primitive thought went astray in that appalling maze. However, to-day, when the actual world and man are revealed to us we cannot allow any one to persist in wanting to keep us in it.

The life of animals is cruel in a different way from ours. Animals endure it without the resource either of suicide or of philosophy. Our intellectual organism, which is superior to theirs, allows us to question the universe and to obtain answers. Can anything be conceived more tempting than to dictate those answers, especially when the questioner, uncertain of the future course of evolution, will not permit us to accept the objectivity of the elements which he pretends to make subservient to human subjectivity?

But man changes more quickly than does the universe of which at no moment is he the measure. He is, therefore, obliged to adjust himself to it, whether he wishes to or not. He must first of all find the courage to acknowledge himself to be one of the cosmic elements, so that he may put himself in his proper place in the universe. And when he shall have discovered that by an outstanding privilege he is a conscious factor in his own evolution and can aid in determining his future, may not his lamentation be changed into deep satisfaction, his weakness into courage, his despair into hope, his renunciation into action?

The family, the tribe, whether nomadic or sedentary, all

the ethnic rudiments of nations at different degrees of social cohesion, and, finally, humanity itself, ideally considered as forming a part of a coherent group of concurrent activities under the law of the strongest — which we must try to make the law of the best — constitute a hierarchy of social complexes the function of which is to enlarge the horizon of the individual by creating for him more stable conditions of life, so that he may direct his energies toward fresh progress.

Provided that under cover of clamorous words, the ruling powers do not set themselves to work to disguise the truth, observation can clearly show what we can realize from these coördinated efforts, ever struggling against short-sighted selfish combinations that are seeking above all a momentary advantage. If we are to judge impartially the degree of civilization which has been attained at any given stage of a social progress of which those who reap the benefits eagerly boast the achievements, we must have approximately accurate measures. And we should probably have them if through laziness we were not prone to confound what is said with what is done. Even though only vaguely defined, the social doctrine of mutual aid is a just subject for pride. Unfortunately the distance which separates it from its application is often too great!

Personal interest atavistically persists in distinguishing itself from social interest, with which it should fuse as a legitimate manifestation of organic egoism without which the preservation of life itself could not be assured. We must protect the organ if it is to develop. A development of a socially-conscious personality would lead man to take pride in an incipient altruistic sensibility and make him swing back and forth between the empirical and the ideal in the rhythm of a prospective harmony.

It is not hard to conjecture what the original human social groups were. Force, regardless of what form it took, was concentrated in a few hands and overcame all resistance from the weak, who were powerless to band together. That fact was, and still is, the most patent element in our history.

Even to-day conditions, though disguised under a monotonous phraseology of idealism, are not greatly different.

Inevitably, philosophers offered their services to help establish harmonious laws of universal equity, which would create democratic justice. To what extent their pretension has been justified in practice is a topic of endless debate.

The establishing of 'rights' inherent in the individual remains, nevertheless, one of the highest conceptions of social man in respect to the general problem of stable relationships. All that we need do is to remember that 'justice' is no more than a word until the day dawns when we can resolve it into conclusive action. As long as our atavistic psychism has not been replaced by a closer correspondence between thought and action, our merely verbal revolutions can in no wise alter the empiricism that has so far prevailed.

THE RHYTHM OF ACTION AND REACTION

The march of social evolution, called civilization, is meaningless except through the evolution of the individual. The human individual is primarily animated by the governing need to live in society. In spite of the incoherence of his life, the member of modern society is in a social condition marvelously superior to that of neolithic man (age of polished stone)—to say nothing of that of the Neanderthal man, or of that of the man of Chapelle-aux-Saints. Every one can see similarities of development among all the stages of gregariousness rising one above the other throughout the ages. The profound identity of civilization under its different forms in different eras and among men of different ethnic strains is the result of those related similarities in every field of human activity.

The biological phenomenon of gregariousness, so remarkably manifest in the human species as well as among many of the vertebrates,¹ is no less distinctly marked in certain articulates (bees and ants) and even in the most elementary organisms, such as the coral insects. In all these social groups I can see nothing except the natural reaction

¹ Consider the schools of fishes.

of superior 'complexes' to the universal workings of individuation. To speak the language of modern biologists, here are two 'tropisms' of contradictory tendency, which determine the progress of the universe through their related oscillations, which occur in 'rhythms' analogous to those of day and night, of the tides, of the seasons, etc., etc. These rhythms recur in every cosmic activity from that of the atom to that of astral cycles; and organic life, which results from them, cannot possibly escape their influence.¹

These rhythmic cadences of cosmic continuity universally set their characteristic mark on the distribution of energy, measured out in *quanta* according to the theory of Planck. Only very recently have we paid sufficient attention to these rhythms, although in the form of sleep they cut our conscious life in half. The aspect of the universe is sensibly affected by them. In the organic world we find only the biological components of interrelated rhythms which are related to evolutionary action through the acceleration or the retardation of their oscillations. Furthermore, the Ego, although it always preserves an axis of value, due, not to any absolute entitary permanence, but to the blend of heredity and of variability by which it is produced, is pre-eminently susceptible of change. If that is so, how are we to understand social tendencies, ethnically determined by innumerable Egos in an infinitely complex confusion of agreement and disagreement?

As among individuals, we find within the compass of society alternate manifestations of strength and of weakness in which we seek the laws of a continuous 'progress.' In that respect, Greece and Rome supply ample material for us to study. Theirs was the greatest success in history, and theirs also the worst collapse into decadence. Athens, victorious over Xerxes, fell before Philip and Alexander. Rome, after having been mistress of the world, turned weak as water under the emperors and became incapable of defending herself against the Germanic hordes. The degeneracy of Byzantium was indescribable. Hannibal prepared his own

¹ Rhythms of the heart, brain, stomach, etc.

defeat at Capua. The problem of social man is to give his energy such breadth of rhythm as may be propitious to the legitimate development of himself and of society.

Nations, or ethnic civilizations, necessarily represent concordant thoughts and similar emotions capable of taking concrete form in a common effort which, as the accidents of history may dictate, will succeed or fail. As to the rivalry among nations to surpass one another in the so-called race to civilization (which is ordinarily rivalry in domination), I hope that some good may come of it. To be frank, I have my doubts when I see cultured nations relentlessly engage in the madness of systematic conquests which sooner or later will arouse the oppressed peoples to revolt. The case is so perfectly clear that one needs no skillful pencil to sketch existing conditions.

If the action and reaction between the beats of the universal rhythm which succeed one another unceasingly were always equivalent, cosmic activity must be a sort of eternal pendulum, the ticking of which marks the count of no one knows what tremors of the immutable. But cosmic life, with its ever-renewed pageant, constantly demonstrates that action and reaction are never equally balanced, and that there result successive evolutions in indefinitely developed cycles. If I knew all the relations of all the cycles, I should hold the key to the universe. We must leave that illusory possibility to blind metaphysics, with the false simplicity of its 'absolute.' Since the loftiest attainments of the greatest human intellects are never more than relative, whatever progress we make will still leave us immeasurably distant from infinity. In that case is it not wise to accept the destiny which is forced upon us? Should we do better to abandon ourselves to a life of verbal indulgence, without any wish to understand the relation between the word and the Cosmos which it pretends to express?

Since the rhythm of regression marks the organic reaction of an impulsion temporarily ended, it has its laws like other rhythms. Planck, with his theory of the distribution of energy to which *quanta* give rhythm, enables us to explain

by means of the *quantum* of impulsion, the *quantum* of the resultant reaction — the inevitable consequence of an expenditure of energy in a direction determined by the law of least resistance.

I outline the general theory of alternate advance and regression in which the activity of the organism progressively overcomes atavistic resistance and thus causes evolution. It is easy enough to understand that no simple diagram can portray the inextricably complex oscillations of which each period of existence is made up. Nor can any chart show the general movement of human history amid the crisscross of social ideas, feelings, and volitions, the results of which are constantly growing more far-reaching.

Interpreted according to each man's capacity, every period of human development must depend on past and future heredity, to the effects of which ensuing centuries will give definite form. That is the problem of history in its fullest scope. In spite of the incredible difficulty involved in accurately defining any positive fact, we have begun to study the realities of history with the idea of extracting therefrom their significance so far as our atavistic misconceptions will allow us to do so. The fact shows a decisive progress in a comprehension of things in the highest reaches of our development. In that field, as in others, we have discovered certain classifications of relationships, and we are able to deduce from them the primary elements of the laws according to which the more or less orderly tendencies of our discordant 'civilization' are perhaps determined.

Thus we see unroll periods of greatness and periods of misery which, as a result of opposing forces, will produce cosmic results from which there is no appeal. Thus, the beauty of great centuries and the wretchedness of unfortunate days can be bound together in rhythms of evolution or regression according as the pendulum swings slowly or swiftly. The nations follow one another in attaining the heights and in plumbing the depths of that general action in which their corresponding tendencies meet and become attuned. Many a nation reaches the summits, only soon to plunge

into the abyss. China knew greatness in ages when Athens was a rocky field and Rome a thicket in which dwelt the wolf. Who shall say what is brewing at this moment? Consider the difference between the Athens of Pericles and the Athens that was pillaged by Rome or the Byzantium in which the Greece of Alexander foundered, and between the Rome of Cæsar and the present-day Rome of the Vatican. How long did Germany, sheltered behind the Rhine, have to await the exhaustion of the old Roman civilization before it could take its barbarian revenge? We need these guide-posts to bring us back to a proper modesty, but they should never dishearten us to the point of abandoning our efforts. The driving force of organic biology, the bursts of comprehension and of will-power, with their alternating advance and retardation, imply a definite tendency in which conscious action predominates over subconscious reflex.

Bouvier, in his '*Vie psychique des insectes*,' describes social organizations among animals so slow in their evolution that they seem to have congealed into automatons governed by tropisms. And yet I have already called attention to the fact that in certain animal tribes and even in certain individuals there is manifested a capacity for adaptation to unforeseen circumstances and for those repetitions of newly learned actions which the workings of heredity convert into Lamarckian habit. I have already pointed out that insects can learn. Thus the insect contributes to its own evolution. It requires much time before it can establish new elements in its heredity. But what are our measures of subjective duration amid the endless time of the infinite Cosmos?

We too learn, and we make use of our knowledge to hasten our own evolution. We are no more free not to learn than we are not to evolve, since the two are merely different aspects of the same phenomenon. Our civilization, with its rhythms of progress and of regression, the constituents of which vary from hour to hour, reduces itself to contests between yesterday and to-day in travail of to-morrow. But of this 'yesterday' and of this 'to-day' we are only beginning to have the vaguest idea. How can we isolate 'to-morrow,'

which is the product of unconsciousness and consciousness fused in a task that has neither beginning nor end?

We are born into the enlightenment of a transient civilization as we are born into the starry conjunction which happens to exist on the day of our birth. Before we open our eyes we find ourselves charged with atavistic impulsions to which a potential of evolution is opposed to a determinism from which our personality results.

In what state of knowledge was Adam created? How did such elements of 'civilization' as he possessed come to him? No one tells us anything about the matter, if not that he knew nothing and was not even warned that he needed to learn anything. There is no allusion whatever to his 'soul,' which, nevertheless, is the capital point of creation. There is not a word about the original development of his intelligence beyond the account of the unexpected struggle between his Creator and the serpent which came from no one knows where. There is nothing about the first assembling of a tribe, though family life, as we know, began with a fratricide. Everything until the formation of the first social systems, which is the distinctive achievement of man, is left in darkness. For positive information we must have recourse to the man of Chapelle-aux-Saints. That venerable ancestor of ours, though dumb, yet speaks. In fact he tells us many things, although never enough for our purposes. In his day, if compared with simian or pithecanthropic society, he probably appeared ultra-civilized. He probably felt pride in things which we should consider beneath our notice. Indeed, it is most enlightening to find in the filiations of a dimly remote past the beginnings of a civilization of which we are, to-day, too ingenuously proud.

GUIDING THE FORCES OF CIVILIZATION

In the earliest times, the task of guiding the forces of civilization necessarily fell to the strongest — or to him who seemed the strongest — who was declared the most worthy, regardless of what constituents entered into his eminence. Judge, prophet, king, or 'tyrant,' whatever embodiment of

authority you prefer, all were subject to the constant threat of rebellion whenever the limit of toleration was exceeded. Between autocracy imposed by arms or by trickery and future liberation there developed those rhythms of acceleration and retardation which were to differentiate our governments, even when they bear identical names. The first problem is that of the 'benevolent despot' whom simple souls prefer, but whose actual value is doubtful even among those 'free peoples' who use — and abuse — the right of self-deception. Can liberty derive from despotism? I doubt it. What value has a 'liberty' which man has not been able to win by boldly experimental acts, the temporary failure of which often teaches the most useful lesson?

Autocracy, oligarchy, and democracy remained for a long time merely distinguishing labels rather than actual facts, and order consisted primarily of disorders, compensation for which was a matter of chance. Ages elapsed before men came to distinguish in their public action between the plan and the execution clearly enough to make the adjustments necessary to a more or less coherent social organism. The famous debate of the Persian lords after the murder of Smerdis, the impostor, shows, as Herodotus reports it, that even in those days 'enlightened' minds were still far from making any such distinction.

If any one ever undertakes to write the comparative history of human society, he may be surprised to learn how little wisdom has resulted from age-long repetition. Not that the general synopses of man's aims, whether public or secret, are hard to determine in the case of any given country. 'Democracy is isonomy,' that is, equal justice for all. The Father of History puts the remark into the mouth of one of his conspirators who carried disinterestedness to the point of refusing to be a candidate for the throne. The thing is soon said; the question remains how it can be attained.

The establishment of an automatic distribution of social benefits by some exalted functionary of sovereign kindness who will scatter everywhere agents of his universal benevolence to dispense 'the joy of the human race,' is the simple

programme of all our quack governments. The fact that man is less a passive mechanism peacefully content with whatever the day may bring than an active organism impelled by his own evolution to apply his own efforts to attaining the maximum of personal satisfaction seriously complicates the problem.

Personal satisfactions are obviously what he demands under the name of 'liberty.' And since individual liberty must be regulated in accordance with 'equality' of rights for all, and since the laborious evolution of our intelligence makes us ever-changing creatures, the difficulty becomes almost insurmountable. On a universal confusion caused by accrued wealth, increased ambitions, keener rivalries, the partitions of castes and of classes, the eagerness of selfish interests, all the forces of oligarchy, the seductions of words, contending passions, the presumption and barbarities of ignorance, the brutalities of peace and the cruelties of war, all the extravagances of rule struggling with the unarmed right that reacts to them now in the spirit of servitude, now in outbursts of rebellion, all the intrigues, all the trickery, all the perfidy, all the self-devotion, all the treason — on that huge confusion, I say, all that remains to be done is to found a universal harmony. It is a superhuman task which every chance ideologist or politician cheerfully accepts, but which the philosopher, cautiously feeling his way, cannot master.

Alone, the tendency to oppression — which is, alas, always tainted with contempt for human rights — found the field free until the abuse of despotism, even when well-intentioned (if the Almighty can be dissociated from his own weaknesses) exposed it to the assaults of those who rebelled against it. So-called 'benevolent despotism,'¹ if it were not naturally unstable, and if men could live without the illusion of liberty, might perhaps solve the problem of government. In practice, however, it leads only to rebellion.

When we consider the great mass of men who are satis-

¹ 'It is astonishing what those who can do everything cannot do.' Remark attributed to Madame Swetchine.

fied with the security which words seem to give, but which is so unlike the actual confusion of facts, it is not surprising that the names of parties and of sects are less important than they appear. How mistakes and disappointments accumulate, and what a crying inadequacy of results! There is, I think, no field of human activity in which men more quickly lose their tempers, or in which they so hate and persecute one another. I do not even except religious dissent, which compromise with secret doubt sometimes mitigates more than any one would dare admit. The peculiarity of 'faith' is that it attaches itself to visionary anticipations of the absolute, whereas politics is obviously a purely earthly concern. And the sole result is to produce an implacable conflict of all the passions in factions that, turn and turn about, exchange the vices of power for the virtues of opposition.

It can be asserted that in the field of government every kind of experiment has been tried, and that so far nothing has been permanently successful. Great empires have lived a life of sanguinary error and through their own fault have crashed in ruins. Many a nation which howled over the joys of the stake, or even over the scaffolds which seemed to give it 'liberty,' sank in the midst of triumph into the abyss of military slavery. Everything happens, and everything is disguised — proud or base victories, noble or cowardly defeats. Is there nothing for it, then, but to repeat it all? It is not so much a question of knowing what, ideologically, institutions may promise as it is of finding out what the virtues and faults of men, which make the wheels of society turn, can accomplish. And contrary to general opinion it is less a question of finding great popular leaders than of finding temporary chiefs who to the point of heroism, even to the point of madness, are capable of giving effect to some simple compromise among different plans of action which, too often from interested motives, various groups of men are advocating. I would sell genius (too prevalent in our day) scandalously cheap if in return I could get strength of character. Too many generations are still awaiting in their

tombs those new conditions which were to bring about a better distribution of political strength.

The briefest survey of the various public forces would be incomplete without some mention of the press. Only in latter times did it enter into the activities of our civilization; its original aim was to broaden, define, and establish from day to day the prevailing trends of 'public opinion.' It has deteriorated into a machine organized for purposes of publication which are sometimes good and sometimes bad, and its output is generally poor even when it approximately expresses so-called 'public opinion,' which is always changeable and never final. This hypothesis, however, is implicit in the activity of the press, namely, that what is valuable in opinion will be utilized in the interest of the public welfare by the majority of readers, except in the case of that conscious or unconscious deviation which results from misconception, whether interested or not.

The evolution of human sensibility necessarily has a controlling influence over all the conflicts which gather round all the intellectual forms of public and private action. How can the press do otherwise than more or less accurately reproduce the universal conflict of sentiments, thoughts, interests, and activities which make up our lives?

I am not going to deny that in ways that are more or less 'regular' all financial, industrial, and commercial interests find in the press important aids to publicity. In respect to all things there is what people say and what they do. There is also even what they pretend. Gutenberg did not find the secret of reforming man; he left him just as the Biblical Creator had made him.

What strikes me in the history of the daily press is that, as soon as it could free itself from its first obligations, it began to serve ideology. The same is true of books. It was the inevitable reaction from the ages of intellectual repression which followed the decay of Hellenism and the triumph of that dogmatic Christianity which was the enemy of freedom of thought. The press, index of the great rhythms of slavery and of emancipation which are the pecul-

iar property of human life, took on itself the task of opening every path to the conquest of ideas. Through three centuries of ideology, the press, which in those days had no daily organ of any consequence, led us to the extravagances of that Revolutionary journalism which Napoleon bridled. Afterwards ideology for a time recovered its privileges until that symbolic duel between Carrel and Girardin which marked the beginning of the supremacy of finance in every form of publicity.

In the short half-century to which my personal observation is limited the character of our daily newspapers has entirely changed. Whether they devote themselves to following public opinion or to trying to guide it, we must recognize that the vogue of the pure idea has fallen into disrepute. That was the inevitable result of the disappointments which followed the attempt to apply theories to practical affairs. In 'An Enemy of the People' Ibsen maintained that newspapers are edited by their readers. The fact is that the enterprise demands an important capital investment which without the coöperation of the purchaser who seeks reading within his means and understanding is quickly lost.

For that reason the old 'leading article' is disappearing, crowded out by advertisements or by narratives of sensational crime which on the front page solicit the attention of a reading public more eager for thrills than for ideas. When the good is duly offset against the bad side of ideology, this state of affairs seems to have at least the advantage of revealing the 'civilized man' of our day in all his simpleness. In the London 'Times,' and in the great American journals, which are volumes in bulk, we find the key to the Briton and to the American — especially to 'the man in the street.' But in an age when only numbers count who does not sometimes find himself 'the man in the street'?

The daily press remains a magnificent instrument for spreading the news. It was originally conceived as a supreme liberating force, the task of which was to control all other forces. That theory is hardly heard of now, for it sometimes happens that the controller needs to be controlled.

In the great enterprise of the profound evolution of intelligence, there remains the press that issues books, a press the moral authority of which luckily can but develop and strengthen.

Since all power persistently tends to expand beyond its legitimate boundaries, I do not hesitate to say that the human Providence which we know as 'public opinion' does not seem to me sensibly superior to that divine Providence which for so many centuries ruled us with a rod of iron. Indeed, the two are closely related, for each derives from the other, and they keep their unstable equilibrium only by balancing one extreme oscillation against another. Public opinion is a power before which we must bow, as we must bow before any superior force. But to consider it as anything more than a transient, wholly empirical decision among contending views is something to which I cannot consent.

What we must remember in dealing with these compounds of the differentiated evolution of individuals is that general evolution, resulting, as it does, from the common assent of a populace in which ignorance or misconception predominates, remains, and seems obliged forever to remain, slow to respond to the too early urging of enlightened intelligence. Gustave Le Bon has brought out with remarkable clearness the important fact that no agreement can be reached in an assembly of men except through the assent of inferior minds — to the detriment of enlightened culture, even when marred by weakness of character.¹ The bigger the mob, the more conservative it becomes, and the result is that it tends to delay all innovations based on verified scientific knowledge. In respect to what we call 'public opinion' there results a dwindling enthusiasm or an inertia, the effects of which are more or less far-reaching. Man,

¹ Unfortunately, extreme universal culture cannot be regarded as an effective remedy, because the most revolutionary laws do not confer on us an even level of intelligence. The selfishness of majorities when they take the form of 'classes,' and are supported by every bovine group and the amorphism of the more or less revolutionary minorities that form and fade as fortune bids together make the history of our civilization.

whether considered as an individual or as a member of society, is simultaneously progressive and reactionary. We are the more excusable in seeking quick solutions, because our evolution requires a lapse of time greater than our span of life.

I am sure I shall be forgiven if I do not go into the question of how humanity can be most usefully guided toward the accomplishment of the exalted lot which we anticipate. I should have to speak of too many matters that are familiar to every one. It is sufficient if I note the fact that under the cloak of disinterested benevolence, autocracies and oligarchies have arrogantly exploited the passive masses in the interest of the classes. The reaction of democracies was to appeal against that partiality to the natural representatives of all the interests concerned — representatives quicker to resort to the violence of battle than to the sure benefits of organization. In view of our experience, the difficulty of realizing the democratic ideal cannot be concealed.

Constructively to appraise the interest of the majority demands first of all that that majority (in which misconception predominates) should be able to look at the matter objectively, and the powerful argument by Le Bon on the inferiority of mob psychology still stands unrefuted.

The 'representatives' of the masses are in the same predicament as are their constituents, and perhaps in an even worse one, since the flesh is weak, and the temptations of power are infinite. On this point it is suggestive that in our own day both Sovietism and Fascism attest a reactionary sentiment even in the common people against the reprehensible practices of 'democratic oligarchies'! Alas, Fascism and Sovietism are nothing but empirical preparations for the return of the old tyrannies. Regression cannot be a remedy for the faults of governments which do not pretend to any ideal.

The fact is that the historic means by which we have tried to counterbalance our weaknesses have seldom produced the promised results. Religions and governments, despots and deliberative assemblies have rarely come up to

expectations. But we must not despair. Men are evolving toward a state of perfection which sooner or later cosmic action will upset. Through evolution itself, heredity and variation will react day by day both on individuals and on society. When the conflicts of human intelligence are at their height, so-called 'progress' must inevitably roll on toward the dreaded unknown.

It becomes more and more apparent how that general average of opinion which, we are told, is the supreme expression of the judgment of mankind, is formed. The authority of that famous 'general consent' grows daily stronger, and yet, as a matter of history, it has accepted everything and glorified everything, both the best and the worst, and has retained of its liberty chiefly the essential right of making its own mistakes. In the meantime, all things considered, where are we to seek our rules of conduct if not in the approval or disapproval of our contemporaries? What is it that makes even Divinity express purely human ideas? Add that the intellectual inferiority of 'common sense' is generally aggravated through the unloosing of congruous emotions the tendency of which is to deceive man on the validity of his questionable 'convictions.' That, to some extent, is the explanation of the cruelty of despotism and of the barbarity of revolutions. He who has no doubts cannot be kindly. So far as what we call 'popular decisions' are concerned, it is obvious that they are reached under conditions of general irresponsibility. Any form of reaction against them is, therefore, easily accounted for.

So far as the relations between the deliberative and the executive power are concerned, I see nothing in which to put our faith except those ideologistic formulæ which can supply us with all the necessary elements of hypothetical systems. The same holds true of the ultimate verdict of public opinion, as expressed through universal suffrage; it is the only resource I know except an appeal to the evolution which indeterminate time may bring about.

Parliamentary institutions naturally can be worth no more than the men who conduct them. It is very easy to

find fault with them or to praise them, according to the period and the country. Such as they are, they have a tendency to produce a venturesome verbal display wholly without stable foundation. It is all a matter of degree, determined by the character and intrinsic worth of delegates sometimes intelligently, and sometimes blindly, chosen. Collective incompetence, no matter with what words its actions are adorned, or how deep may be its schemes, cannot give life even to the smallest fraction of the ideal. In various countries we have seen parodies of parliamentary government lose authority when the blame could be imputed to no other cause than the common incapacity of the electors and of the men elected who represented them only too faithfully.

In spite of every crisis, the right of free speech, if we may so call contests of opponents of different degrees of ability, must prove beneficial in the long run. In many ways, man may misconceive what is for the public interest and misuse the right of criticism just as he may misuse authority. It also happens that, even when inadequately organized, public authority may surpass the expectations which it has aroused. That is rare. Government, parliament, and press are fully alive to what reproaches they are open. The most republican of republics can be an advance only if it helps man to govern himself.

Indeed, to establish institutions on paper and to administer them in harmony with their spirit are two very different things. Man conceives grandly and persists in living meanly. The discrepancy between what we say and what we do lies at the very heart of our difficulties. Moreover, we magniloquently discuss rules which we are eager to apply to others, but which, whether consciously or not, many of us do our best personally to evade. Under the yoke of our inadequacy, we are all eager to give the best and the worst of our darkened and even sometimes enlightened consciousness. And, as to the triumph of character, the wisest course is not to count on it.

Unfortunately, such is the summary of the whole history

of our civilization, the sublime but tottering formulæ of which promise only remote realizations. Compare what India dreamed with the effective amount of living thought that has come down to us; what Greece strove for with what it accomplished; what Rome did with what has survived; what Christianity promised with what it has performed. Such a comparison might make us more modest, and not too hopeful of our posterity! Everywhere and always we discover grand hopes and lofty resolutions which only too often are made an excuse for violence, and which, throughout the stormy hours, send us headlong to the disappointments and to the anxieties of a future before which overtaxed imagination falls exhausted. It matters little if the lighthouse goes dark, if we remain eagerly expectant of the coming illumination of new torches.

It may be said that these opinions are not over-encouraging. Quite possibly. I seek the true explanation of the phenomenon in order to adapt myself to it. I do not seek to adapt the eternal Cosmos to the especial exigencies of my life, which is no sooner come than gone. We are not gods; that is the great discovery that I allow myself to submit to my contemporaries. May I be permitted, nevertheless, to prefer man's estate to that of the snail, and since I am man in the course of evolution, to seek to develop my knowledge to the point which will give me the most comprehensive view of my earthly transit? And how can this capacity to know express itself if not through the incessant activity of energies regulated according to the laws of that Cosmos from which we spring? What finer use can we make of our ephemeral lives than incessantly trying to increase and develop this achievement of energy, described as 'civilization,' according to the universal laws which open the way to ever higher realizations, and which result in a continuous enhancement of human dignity?

What can we do, if planetary evolution is merely a function of the cooling of the sun? What was your God doing in the black eternities of negation which followed one upon another before the idea occurred to him of that incongruous

creation of which you insist we are the crowning accomplishment? Is it certain that the inadequacies of the creature do not correspond line for line with those of the Creator? Let us try to be fully what we are and what we can be, and you will see that the Cosmos will take care of itself.

Is it then idle for us to seek amid the agitations of public life which determine the crises of human destiny the right criterion of personal and social behavior to unite men of good will? The social organism is, like the individual, a living unit. It is a unit of groups united in a perpetual rivalry for domination. Ask the executive body not to encroach upon the legislative, and *vice versa*. Ask the individual not to invade the rights of others. Underneath the history of our human charity there is too often a nest of hissing vipers skillfully hidden amid the metaphysics of the historian who acts as snake charmer. The magic of the written word often cleverly transforms history into a tale of the devoted coöperation of men. Whoever has actually watched the current of history flow by will always distrust the enthusiasms of the most honest historian. In spite of the admirable effort made in modern times to reconstitute the history of the relationships of men throughout the ages, the atavistic Sorbonne, represented by men of high culture, suggests that we admire the powerful rhetoric of that 'Histoire Universelle' in which Bossuet tried to depict the historic world in legitimate gestation of Louis XIV with his overbearing personality.

Perceiving this, Galiani went so far as to say that modern history was nothing but ancient history with the names changed. That is arrant nonsense if we take the remark in an objective sense, but only too just a criticism if we consider the idle superfluity of interpretive theories. The history of man is that of an organic evolution, the course of which we must trace from its positive antecedents to its positive consequences, even as far as the gateway of that better future to which the past has brought us.

By whatever name adorned, our governments are compromises, whether declared or disavowed, and are con-

stantly changing oligarchies around which passively gathers an amorphous crowd whose efforts tend to refinements of speech in which idealism and self-interest, mixed in varying proportions, reach an equilibrium. Therein lies the explanation of the fact that superabundant discussion is perhaps too often regarded as conclusive proof of civilization. Excessive talk inevitably results whenever the principal effort of the mob is to make a choice or to listen to numerous harangues fitted to its momentary comprehension — or momentary lack of it. To maintain the solid conservative interests under a change of label which passes for 'progress' is the automatic tendency of civilized society and over and above vague words assures us the lure of visions the stuff of which will be what is most beautiful in life transposed from the realm of empiricism to the realm of the ideal.

Let no one suspect me of irony. Should we really be so much to be pitied if, through 'fertile illusion,' we found ourselves prematurely in the precarious possession of what at the start can be no more than a dream? We must not despise the precious thrills given us by a tireless imagination.

The authority of leaders of all sorts, which was exercised in the countless ways recorded in history, only changes the appearance of the important problem. Whether military or civil leader, the man who at the risk of not being obeyed presumptuously wishes to govern is permitted to rule only if he first guarantees to preserve existing conservative elements without too seriously impairing the hope of change. It is all a question of degree. Absolute rulers, or those who come to power through the accidents of inheritance, are invariably represented as miraculous geniuses, although their principal strength most often derives from the automatic submission of the masses, for the moment in the cadence of apathy that follows the high note of war or of revolution. How long-continued is the reaction against the misunderstood, the flouted ideal? Generally, men let everything go, and we know only too well what is the result. Even to-day, Napoleon's lack of foresight in the Russian campaign has not impaired the romance of his glory. Sup-

pose that the man of Moscow had been subject to the most elementary criticism, and tell me what would have been left of his fantastic project. Imagine the same degree of criticism existing at the period of reconstruction that followed the great convulsion of our Revolution, and ask yourself what would have been written in history.

Civilization was in fearful peril when the Macedonian conquest put an end to the remarkable intellectual eminence of Greece. It is appalling to think at what a price of lost greatness, at what a cost of degradation through the Roman conquest, the evolutionary force which makes for civilization, again confronted by a blank wall, was able to animate races which the antique world deemed incapable of any progress toward civilization! Leaders given to every brutality, leaders in whom order and disorder were commingled, leaders compounded of stupidity and clairvoyance, loquacious leaders, incoherent leaders, vigorous leaders, and inert leaders — all men in whom good struggled with evil — have at times manifested irrepressible passion in which, in the midst of vertiginous happenings, flashes of intelligence indicated the existence of a deep underlying order in the universe and in ourselves.

In the case of those resolutions which men make when their whole emotional nature is stirred, it is not surprising that their organic reactions, free of all control, should sometimes simultaneously result in contradictory and extravagant deeds. The fact is that an identical law governing both our error and our truth leads us back to forms which seem irrational in our eyes only because our standards of time are so inadequate to measure the disproportion between our organic evolution and the general evolution in which it is included. In all the activities of so-called leaders, whether in fact they rule or are ruled, there is not a single shift in equilibrium which is not in time counterbalanced by a corresponding countervailing reaction in the established course of human activity. The same is true of the actions of the irresolute mob.

It is impossible that a statesman shall not sometimes

yield to the powers of disorder. The greatest minds are bound to encounter all sorts of circumstances in which, amid the diversity of the accidents of life, the element of the unknown has too much the advantage. What can result except that by various unforeseen ways all events in some manner become adjusted to the advantage of an ultimate order, the form of which we cannot now foresee, but which may some day take definite shape? Indeed, it must be so, since in spite of the most serious mistakes of those who are, or who believe that they are, in charge of government, the destined evolution proceeds on its course.

If that be so, some will say, why should we exert ourselves? Should not the fatalism of the Orient be the last word of life? What reason is there for man to expose himself to the dangers and painful anxieties of action if the vicissitudes which he encounters, no matter how various, must lead him to the same result? What matters the distinction between error and truth if in the final reckoning the sum total is the same? Why should we live if life is nothing more than a vain apprenticeship to a task that we automatically repeat?

It is not for me to justify the Cosmos, that is, to reconcile the mechanism of the stars with our variable sensibility, which can expect no more of an accounting from the elements than the sensibility of any other animal that, because of the superabundance of competing lives, finds life a hard struggle. An animal's reactions are limited by its organs. And we, who have inherited the atavistic tradition, are limited in the same way. No more than our ancestors have we the means or the right to any particular privilege.

To ask why our sensibility reacts as it does is the same as to ask why we persist in living. I consider that the decisive answer is that, like every other living thing, I have my origin in hereditary conditions which I did not seek and for the development of which I am in no degree responsible.¹

¹ The supreme incongruity of our celestial world is that it simultaneously proclaims us responsible for the lives we lead, and admits that we are not responsible for our birth, which determines our lives.

As a guest at the impromptu feast to which I sat down when I came upon the earth, why should I not take my share of the joys of vigorous living which brings out that sense of dignity in which the full perfection of the phenomenon of existence is realized? To live as your Creator lived before the act of creation is not to live at all. I am living, and whatever may be the length of days assigned me, the law of my being must be to make full use of it.

Therefore I will act, that is, I will consent, like every other being, to develop my life under the conditions imposed on all living creatures. Except for recourse to the privilege of suicide, that is, flight when the battle is fiercest, I have no other choice than to spend myself as the organic laws which rule my activities direct. Endowed with the highest degree of consciousness amid the developments of life, can I complain if, within the limits of my relative nature, I succeed in finding out what I am, what I do and what I can venture? How can the sense of this activity and of its evolutionary tendency induce me to despair of myself and of the universe at the very moment when my hand is about to grasp the keys of a knowledge which is based on cosmic experience and in which I discover the widening scope of my personality? I shall not stop the shedding of blood, I shall not give life to any prevailing ideal of liberty and law. Then what? I shall realize no ideal. But if I can think more nobly than I can act, is that a reason for deserting when I find myself at the post of honor? Far from it. The greater the danger, the harder it is my duty to fight.

From the remotest ages, when Asia tried to begin the realization of human greatness, our ancestors have proudly pursued the noble task. They strove, and since we are the living proof that they strove successfully, they have transmitted to us the obligation of effort. Let each of us then take up his task. The civilized man is the man who perfects himself through penetrating ever deeper and deeper into the secret of the universal laws which he indefatigably tries to make clear. What could be finer than for each of us to determine his own destiny?

In the measure in which the majority can hold together in order to put questions, if not to answer them, all civilized nations have been busily engaged in the quest of a government which, with or without the intervention of Providence, should yet be a Providence to them. What has been the result? We learned that might is right, and that idealistic phrases are invented to save appearances. Let us try to do better. The world is not, and cannot be, a matter of ideology. We can, nevertheless, progress harmoniously if we are willing to put enough of ourselves into our contacts with our fellow-men and with the universe.

'Good government,' said Campbell-Bannerman, 'cannot take the place of self-government.' This sarcasm by an ideologist who has a touch of British empiricism no doubt means that it is better to err in the conduct of our own liberty than to travel the right road by the practice of an imposed doctrine of which we know neither the how nor the wherefore. I am ready to admit that there can be no 'good government' which does not permit the free exercise of human faculties, even at the risk of errors from which we may appeal without carrying our zeal to the point of hating and fighting one another for the sake of words which represent no sufficiently objective reality.

Righteous anger has played an important part in history. A tinge of skepticism might, in many cases, have made that anger less bitter. To-day we do not feel obliged to destroy one another in our efforts to attain an eventual super-human perfection. It would be a fine thing if in the name of that tolerance which our relativity requires, we could give full scope to the natural activities of man, letting those activities neutralize one another. Those 'good' elements of which we are aware are the expression of the natural harmony of our organic activities and of the universal forces which engender them. If that is not true, then, like the slave at his millstone, we can do nothing but turn the wheel, and can accomplish nothing beyond exhausting ourselves. On the other hand, our natural exercises, properly ordered, will give scope to what is best in us, and through

that best to the best that is in our companions in this troublous life.

WAR AND PEACE

Is war really the natural condition of all living creatures? The controlling law of the universal struggle for existence so decrees. We have only to look about us to become convinced of the fact. Everything conflicts. Every element reacts against every other. Even mutual aid is but the substitution of one possible combat for another. To be sure, fighting can continue only in a rhythm of alternate intensity and relaxation. Do the periods of relaxation, which are sometimes brief and sometimes prolonged, and which are but opposition under new forms, succeed in creating the elements of that increasing stability called peace, that is, a struggle under better control?

What is war and what is peace? What distinguishes them in their methods, in their arrangements, and in their results? Since war is a method by which humanity destroys itself, peace might appear as a reparatory rhythm in which human beings abandon themselves to the oscillations of a compensatory altruism. Thus, indeed, words paint the picture. Nevertheless, how can we fail to discover under our altruistic phrases the brutal reality of unchecked egoism?

The fact is that the law of the struggle for life universally sets men to quarreling over those appropriations by individuals which are the condition of their existence. 'Economic war' is the current phrase for describing this state of affairs. It seems to me an accurate definition of our armed peace, which is actually only another form of war, though slower in its effects. I will not dwell on the pacific phraseology in which we disguise economic war, which, quite as much as armed conflicts, sheds the blood of the weak in order to increase the vital resources of the strong. The case is too plain to admit of argument. It is true that on the field of battle, as in the wars of peace, we have reached the point of gathering up the wounded and of dressing their wounds. These are but two rhythmical reactions which,

based on an identical impulse to help, impel us to make partial reparation for the evil which we have conscientiously brought about.

Our ideology has grappled earnestly with this difficult problem, a fact which has the supreme advantage of keeping the question pending as much in our uneasy minds as in our emotions. If there should result from it the abolition of violence, I should be only too delighted, but I am afraid I must admit that such an outcome does not seem to me probable. I do not see that the peace of the strongest, with its treaties — 'scraps of paper' — has produced any appreciable degree of security. The institution of a peace-parliament¹ no whit changes the unavowed cupidities, the combinations of opposed interests, or the hypocritical discussions with which we seek to disguise them. However the seat of force may shift, the peace based on superior military strength will still long be imposed on the world, and its frightfulness will be justified on empirical grounds.

By way of diversion, conquerors and 'saviors' may appear. They will be men like Alexander, Attila, Buddha, Jesus of Nazareth, and great hopes will be founded on them. However, on every occasion when peace is violently disrupted, man will be called upon to save himself.

If war and peace both derive from the driving power of the struggle for life, war will continue to produce only increased carnage, whereas peace unquestionably holds out hopes of that approximate justice of which man is capable, and which, for a long while yet, will be hardly more than a balancing between lesser evils. Even so, such a result should not be disdained. War noisily concentrates its massacres within a small compass. Peace parades its inadequacy everywhere at once. Justice is an abstraction, an absolute; man is a complex of relativities, a link in a chain of beings, a transient synthesis of organic impulsions which

¹ As I write, for example, our 'statesmen' have succeeded in obtaining by a lavish outlay of words the entrance of Germany into the so-called 'League of Nations,' where its promises will have the same value as those by which it guaranteed the neutrality of Belgium, only to violate it openly without even resorting to the ordinary expedient of dishonest pretexts.

bring about the more or less acceptable decisions of the law of the strongest.

If the law that imposes a universal struggle on all forms of life results in unavoidable contests in which everywhere and always the strongest triumph, it behooves every organism to continue its individual effort to attain a less miserable state, according to the pattern and in the proportion imposed upon it by its personal complexities. Among animals, hunger is the cause of war and, when hunger is satisfied, their recruited energies merely make them ready to renew it. Thus, without further theorizing, was it to be with man. Nevertheless, with the aid of the conventional phrases, he will some day be filled with pity for himself and for his fellows. However, the transition from a condition in which blood is profusely spilled to the kindness of a 'peace' in which murder is no more than the result of *laissez-faire* will be a real achievement of 'progress.'

The conspicuous difference in ability which must always distinguish men became evident on that day when, after having made use of a stone or a club in his battles, he singled out a flint, considered its qualities and tried to utilize the advantages it offered him, and attempted to reproduce those qualities in even better form. In so doing, he created the tool — a tool for use in peace, or in the chase or in war, as occasion prompted. With paleolithic flint civilization appeared upon the earth. Through a miracle more wonderful than any of those of which we are told, a series of successive utilizations was to induce the prodigious accomplishments of industry and the realization of the accompanying dreams, that is, the simultaneous increase of all the forces used indifferently in war and in peace. New activities, new methods by which to struggle for every possible development of human existence came into being, for the adaptation of the tool to domestic use was at the same time bound to suggest in addition military adaptations with which to defend what we had appropriated and to conquer by force, aided by ruse, what others had taken possession of. Thus an ideal both of war and of

peace was created and was handed down from a time when war and peace were hardly distinguishable. Turn by turn, war and peace rhythmically succeeded each other and increasingly emphasized the differentiation of means to accomplish the same violent aims, and these very means were the starting-points of a forming civilization.

Without dwelling on the consequences, I will merely call attention to the inevitable connection between the wrought flint as an industrial tool, and the arrow used for hunting or in battle. To characterize those consequences it is enough to note the parallelism between the organizations of peace and the organizations of war, each in their turn constructing or destroying as if in an automatic rhythm the successive beginnings of an incipient civilization. At the start we can do no more than take note of the sudden accesses of open violence in war, and of disguised violence in peace which succeeded one another throughout the ages, however much manners may have been refined by the verbal progress of civilization. The advantages of peace increased. In spite of the mitigating effects of a better systematized expenditure of energy the horrors of war were also increased, for they were aggravated by that brutality carried forward from the earliest times. Amid the rhythmic rise and fall of races we nevertheless see the finest flowering of art and of intellectual cultivation develop in the same soil as the most atrocious cruelty. This was as true in the period of the Peloponnesian wars as in the period of the Renaissance.

Search the ages of history as you will, you will find only successive periods of peace and of war, sometimes hard to distinguish, and the preaching of human charity and the glorification of barbarity often intermingled. The exhaustion of war imposed peace; the ineffectiveness of peace fomented war. There resulted alternate periods in which war held the place of honor in the emotions of the people, since peace was too often only a time of preparation for new conflicts. The progress achieved in peace brought forth engines of war by means of which slaughter was indefinitely multiplied. That progress was such that to-day we count

the killed and the wounded by hundreds of thousands and by millions, where formerly tens or hundreds or thousands satisfied man's craving for slaughter.

For a long period history was nothing but an accumulation of warlike deeds, and of descriptions of battles. Indeed, only in our own day has the historian discovered peace and analyzed it. Ideology, however, did not wait; long ago it preached the ideal of an indefinitely prolonged peace. Before the Abbé de Saint-Pierre, the Amphictyonic Council of Delphi was charged with the task of keeping peace among the peoples of Greece. The Council itself supplied the occasion for two Holy Wars, which brought about the final defeat of Athens. Ever since, a reëstablishment of the Council has been proposed and welcomed for oratorical purposes. We even conclude treaties of fictitious disarmament, under the shelter of which actual armaments daily increase.

Perhaps the hour has come when we should ask ourselves, yes or no, whether there are cases in which war is a positive necessity, or whether some way may be conceived of obtaining without war legitimate indemnity for offended justice. When the theme is left to rhetoricians, we know what happens. We are not concerned here with oratorical effects. We seek, by means of scientific observation, to recognize whatever may indicate such a change in humanity as will allow us in all sincerity to expect the suppression of war through arbitration or through contractual engagements destined to be miraculously respected in the most terrible crises. Ideology knows no obstacles. That does not free us from the obligation of judging the proposed arrangements and of estimating the chance of their success.

I am obliged to observe that the emotions evoked by war are everywhere more active and more romantic than the bookish ideology which expects universal peace among races which so far have agreed in nothing except mutual slaughter. Consider all the manifestations of national art in every country in the world; you will find universally supreme among them representations of war, which is

celebrated by monuments, by statues, by paintings, and in poems and in songs for use in popular gatherings. I say nothing of governments; conquerors hold the place of honor among them. Is it necessary to contrast the rush to manufacture every engine of war with the colorless assemblies where in ostentatious language a peace of 'scraps of paper' is elaborated?

It may be objected that there may be advantages in putting some fragment of illusion into the lives of the people. The point seems to me highly debatable. At the moment, that course would not be free from danger, for the aggressor alone might be prepared. In view of the fact that one of the parties to such an agreement not long ago had the effrontery to abjure its signature before the whole civilized world, are the guaranties equal in value? Would even the most incompetent of bankers offer new credit to a customer who but yesterday boasted of having failed to meet his obligations to him? Such are the pastimes of our extravagant ideology.

Victories and defeats! From the remotest times they have been the subject of the songs of our poets, the fictions of our romancers, the writings of our historians, the lessons of our most famous educators. And I am not surprised at the fact, for I would not dispute the beauty of the heroic impulse which inspires man to supreme self-sacrifice in the defense of his right to his home, to the august independence of his fatherland, to the safeguarding of the law that protects his dignity as a man. He kills, but at the same time he offers the sacrifice of his life and of his most cherished hopes for the cause which lifts him above a destiny in which failure and triumph succeed each other as events may decree.

At one time, victory may be the starting-point of a race to domination at the expense of enemy coalitions; at another, the shortcomings which form an obstacle in the path of continuous united action result in unexpected failure. In the same way, as circumstances may fall, defeats may either produce the finest results of victory or complete

an irreparable exhaustion of energy. It may thus happen that in every defeat there is a preparation for victory, and that in every victory there is the potentiality of defeat. The fact is that historical formations must constantly be recast, must constantly be returned to the workshop. Turn by turn, force protects the just and the unjust; but force changes its place as often as does the ideal of justice. How many are the irreparable miscalculations in the formulæ of our dreams!

Do we want to argue? The grave contracting parties, gathered around a table, know that the delicate point in treaties in which nations and governments exchange pledges lies in the inevitably dangerous moment of putting them into effect. That is 'the psychological moment,' the moment when the public safety is in question, and when any pretext will serve as an excuse for not fulfilling an onerous engagement. What is going to happen to that party to the treaty who in good faith has permitted itself to be disarmed? Speaking of the intrinsic force of the sentiment of justice, have I dreamed of a partition of Poland between three unscrupulous sovereigns, and of an invasion of Belgium by the Germany which had guaranteed its neutrality? What sanction is there, I beg you? La Fontaine, speaking of the imprudent lion, says: 'They let loose some dogs upon him.'

No one can deny that war created nations by fixing the boundaries of their countries. Is not a good system of defense the highest security? But who can guarantee that a day will not come when the offensive will be regarded simply as a bold method of defense? Have we then no guaranties on any side? What good is there in lying to ourselves? Why stake everything on the turn of an ideological card? The signatories of an international treaty differ in history and culture. If opposed interests equally solicit them, is it proper that a semi-civilized state should cast the deciding vote to determine the fate of one of the great historic nations, whose very greatness has united against it too many interested votes? Furthermore, I have assumed that

all the great military powers loyally participate in the pact. If not, the whole thing is useless.¹

Finally, must I mention those sanctions without which the whole ideological edifice of universal equity will crash to the ground? That is the decisive point which men have so far most carefully avoided — and with good reason. Asking for general disarmament is asking for nothing less than that the great nations which have hitherto governed the world by imposing their wills upon it more or less openly and selfishly, shall abdicate their independence. The nations that have great military or naval strength will hardly consent to make use of that strength in order to purchase with their money or with their blood a precarious peace between two nations the future strength or weakness of which has for them either a merely academic interest, or else an interest too vital for them to pretend to any disinterestedness. To what extent can we count on the heroism of an executive body made up of incongruous elements to exercise a superhuman equity in the decisive hour when tragedy or self-interest shall speak louder than sentiment?

Is that tantamount to saying that we should renounce any attempt to make agreements for the purpose of avoiding war? I make no such assertion. As to prevention of war, any sort of arrangement would seem to me auspicious if it had any chance of producing conditions fit to maintain the independence and dignity of the contracting parties. If that requirement is not met, I turn to the side of Vauvenargues, whose self-evident axiom is that 'war is not so onerous as slavery.' I only ask that we shall not aggravate the evil by creating additional chances of incurring catastrophes worse, perhaps, than any that have gone before.

Human weakness is fain to hide behind purely verbal formulæ of equity in order to excuse moral failings and to

¹ The Court of International Arbitration, on the use of which we can no longer cherish any illusions, seemed more practical. However, it is not more efficacious. Witness the wars that have followed its establishment, and the fact that not one nation has invoked its good offices.

postpone its day of reckoning. Is it not painfully certain that for the aggressor war has both published and unpublished reasons, and that the latter are too often the deciding factors? Can we believe that the art of lying to others as well as to ourselves has exhausted all its resources in the course of the ages? The problem is not of changing the circumstance but of altering the basis. When the only wars waged are civil, will not an all-embracing pacifism still have a notable field for effort?

Must we, therefore, conclude that existing conditions are to be prolonged indefinitely? I do not wish to assert it. We have merely to choose between two kinds of civilization: one which awaits that slow progress of future evolution in altruism which it is our most important task to hasten; the other, one which loiters over changes in procedure that under a mask of novel phrases leave the basic atavism unaltered. Such is the fate of ideology, which thinks it sees the whole man in the ideal, when the most exalted thoughts leave him a creature of flesh and bones.

My invincible confidence in the happy evolution of the human species does not, as I see it, oblige me to anticipate the future by means of verbal fictions insufficiently related to the organic condition of present-day humanity. On this point our past experience of revolutions, which soon lose all sense of direction, and which are followed by violent reactions, is only too conclusive. It is harder to exercise from day to day a modest degree of justice than through the trickery of words to exhibit to the world a miraculous transformation of humanity. Meanwhile let us work. What we need is less talk and more action. Let us do each day our appointed task. But when we are in the depths of the valleys, we cannot be expected to pose on the mountain tops.

It has been scientifically established that after the formation of the social complexes called nations we can conceive a social complex which will embrace humanity in general, and which we must never cease to seek, although appreciating that we shall have to wait long ages for the realization of our

ideal in any durable form. The nations are so far from establishing harmony in their own domains, even when the people are of a common ethnic strain and of a common culture that we cannot seriously anticipate any deep sympathy and understanding among peoples whose whole history has been, and still is, one of perpetual dissension. Between now and the time when humanity shall have reached a higher stage, let us hope that men will declaim as little as possible. That is a consummation most difficult to reach. So long as man shall be what we see him to-day, may he be permitted to consecrate himself to the ideal of a higher humanity, either, as occasion may require, through the daily sacrifices of a life of abnegation, or by completely devoting himself to an armed resistance to armed aggression. Through every form of violence we progress toward an ideal of peace, some parts of which it may be the fortune of our posterity to realize — parts that, alas, will be all the fuller of risk because they are greater and nobler.

PEACE

The institution, or even the idea, of a perpetual peace is the irreducible characteristic of the beginning of civilization. What was that primitive 'civilization' which transformed the implement of peace into an implement of war? I see two factors: the ideological impulse which projects man beyond his actual condition and the countervailing empiricism without which the ideal would have no fulcrum on which to rest. Ideology is likely to disappoint us when we undertake to realize ideas in the field of actual experience, because it easily satisfies the incalculable number of persons content to live on words having no objective reality. Nevertheless, we have no right to disregard the fact that that same ideology is a characteristic of the human species, which cannot be itself unless it idealizes.

The truth of the matter is that the task of human thought consists of tying together in the form of ideas not only observed relationships, but also the premature explanations of the imagination, which is prone to anticipate. In that re-

spect, the idea and the dream are one and the same, and so continue until the day comes when contrast between science and fiction brings a deadlock which it is the problem of humanity to break. Unless adapted to the actual forms of real life, civilization of any kind is nothing but a mirage. Unadulterated ideology transports us into the empyrean for the childish pleasure of a flight among poetical misconceptions, until the time comes when the natural gravitation of thought brings us back to earth.

The gathering together of the tribe — a wandering group of families — determines a range that, increased, becomes a nation. There is no organism without its corresponding environment, which serves for those interchanges of assimilating activity, which are the original condition of life. Outside a nation, there could be none of those grouped actions and reactions, the interplay of which was to constitute the start of 'polite' life — our so-called civilization.

If we limit ourselves to the recognized forms that nations assume, we meet first of all the notion of the State, in which to install authority and thus to attain self-expression. The elementary simplicity of the problem in its original aspects would naturally lead to the creation of a primitive autocracy supported by groups of oligarchies. History clearly shows how eagerly men have accepted all ideas which oppose despotism and servitude, and from which evolution still has the task of bringing out the orderly activities of justice and liberty. Unknown thousands of years had to pass before men began to resort to the discussion of points which were of fundamental interest to them. Every form of violence — murders, risings, massacres, triumphant or suppressed revolutions, excessive tyranny or incoherent anarchy — has been successively exhausted and has produced only a befogging and confounding of all theories of a permanently peaceful order.

I have mentioned that in their despair, the Athenians, models of a civilization based on democratic oligarchies, came to choosing their magistrates by lot, irrespective of fitness or morality, just as Grippeminaud settled ques-

tions of justice by a throw of the dice. Furthermore, remember that, according to Herodotus, Darius and his accomplice after the murder of the false Smerdis amused themselves with an academic discussion of the relative merits of autocracy, oligarchy, and democracy — only to end by referring the decision to the neighing of a horse. Centuries pass. When Montaigne could not reach a decision his friend, La Boétie, had the courage boldly to attack the dangerous problem of why the masses mutely submitted to the despotism of a single man when all they had to do to get rid of him was to refuse to obey. His was the case of an independent mind which boldly hoped for the eventual action of emancipated intellects. It is interesting to note, however, that he did not undertake to set the example. His own evolution was not yet accomplished.

What satisfaction can we take at a time when theorists constantly want to change everything in accordance with momentary conditions? There is no power which is not a sort of abuse. There is no liberal impulse that is not in danger of giving out at the critical moment. Whatever doctrine fallible man constructs, he will inevitably fall short of it at some point. Constant criticism is necessary. The well-advised reader knows what has been said on all these questions and what has been done. If it were enough to preach morality in order to bring it into practice, our societies would always have been admirable models of all the virtues.

'The principal aim of every human group is to become more and more conscious of the social structure in which it is included, so that it may become more and more thoroughly conscious of the rôle that it should fill in it,' writes Lévi.¹ Before that aim is accomplished, we must travel far. Much ink has been lavished on how religion can help in this matter. Since all systems of morals, whether religious or lay, preach the same doctrine of mutual help, the assistance of all of them cannot but be advantageous, if it really enforces them without seeking ways of encroaching on the

¹ Sylvain Lévi: *L'Inde et le monde*.

liberty of the public, as was done by the Inquisition and by the sanguinary plagiarism which the French Revolution made thereof.

Though public action may be weak or exhausted, the field for the individual exercise of brotherly love remains unlimited. We run no risk of overstepping it. Society would be incredibly admirable if each one of us should require of himself even a little less human charity than he demands from others. Civilization cannot subject the individual to the community except only so far as may be necessary to the application of a rule of peace through which he will gain that increase in personal worth needed to carry him from primitive cannibalism to the nobility of a Saint Francis of Assisi, thanks to an idealism, alas, more easily expressed in our talk than in our lives.

Indeed, we shall have to proceed to the formation of a new man. Ever since the days of savagery we have remained subject to the law of the strongest. And, since we can control the laws of the Cosmos only by obeying them, our problem is to bring it about, if we can, that the strongest shall be the best — the principal difficulty being to obtain their assent. Can we, in this innovation, discount the element of the unexpected? I am no prophet. The weak find it to their advantage to demand all the virtues in other people. The strong want to calculate where lies their advantage, and since the eventual benefits of another life must at all hazards enter into their calculations, it may very well be that in their attempts to dupe others, they have duped themselves. Good arithmetic does not preclude respect for, and even love of, your neighbor.

THE STRONG AND THE WEAK

Since the evolution of civilized life tends to transform acquired habits into the habits needed for a better adjustment of the relations between the individual and the community, the effective value of that equitable reconciliation of interests which we call 'law' is the hall-mark of the idealism of civilization. Before man had even attained to

the conception of any intrinsic power of 'law' in the relations of human beings, the fundamental constitution of the family required a statute, whether tacit or formulated, governing the status of the woman and of the child. In the different forms of that statute we should find a first measure of 'civilized life.'

To understand the psychology of the very strong, it is first necessary to understand the mental state of the very weak. It is generally known that originally the rule of the strongest made of woman a mere piece of merchandise which moral depravity helped to degrade to the lowest depths. In that respect the Orient set only too glaring an example, which the Occident appropriated when circumstances favored. The sequestration of women, the castration of their guardians, and the tortures which in China the most respectable *pater familias* inflicts on his daughter to prevent her walking, are actual survivals of a cruel past amid the ostentatious verbalism of the present.

It is not surprising that primitive man should have been barbarous. What is surprising is that his much vaunted civilization reconciled the refinements of his inexorable egoism with the no less keen refinement of his 'polite' life. The old slavery of woman has lost its most brutal forms,¹ but her complete emancipation is still to come. The fact is painfully apparent in those foul brothels where the bestiality of man likes to confine woman to the ultimate degradation of both. No one can deny that man is principally responsible for the degradation of woman, who, however, contributes at least a passive coöperation.

The husband, the father, was formerly, and in many countries still is, a despot accountable to no one. Even among ourselves, he has preserved some elements of authority which may occasionally be explained on the score of woman's instability, the result of her retarded evolution. It

¹ The trace of it, as Herbert Spencer has very correctly remarked, can still be found in the rings (formerly used as fastenings) with which woman ornaments her neck, her arms, her fingers, her legs, her toes, her ears, her nose, and her lips.

is not enough to proclaim that the enslaved creature is free. She must be fitted to govern herself without damage to the machinery of orderly social life. See what has happened in Russia where the executioners of the Tsar have simply been replaced by the executioners of ideology. In revolutionary France, the guillotine became the successor of the tortures of the Place de Grève. Repudiation, formerly the current practice of Rome, is at the present time replaced in our country by divorce, which puts the two parties on a parity, and which offers the same disadvantages and the same advantages to both. Cato threw his daughter into the street. The Chinese still casts his daughter into the ditch; and yet, the civilized woman, queen of the home, through the accomplishment of her family duties, through the progress of her culture, has established her lot on a constantly more dignified footing.

The wife, priestess of the family hearth, is proud to sink her identity in the mother, and to make the complete sacrifice of herself for the benefit of her children, who often completely fail to comprehend her greatness until they have themselves suffered from an inadequate return of their affection. It was the mother who, before the man, pleaded for the rights of the child and knew how to bring out their importance with an ardor which nothing could discourage. It was the mother who shamed the husband, whose egoism, absorbed in the struggle for life, sometimes made him neglect his duties as a father. It was the mother who in complicated cases faced her children's enemies without pausing over the trifling question of who might or might not be right. The mother, too often abandoned or martyred, forgets everything except the sacrifice of herself and does not even ask for the filial gesture of which she has no need in order to keep on loving. It is the mother, with her most precious emotion, who leads her children to the gates of alluring and cruel life. If they are worthy of the woman to whom in the fullest sense of the word they owe their being, they will wish to repay in some form the debt of the past, so that, through their aid, the effusion of maternal devotion may have its full effect. They will have their chance.

I brush aside the question of the political rights of the two sexes, for, according to the time and place, they depend preëminently on the degree of intellectual and moral emancipation. At the point to which woman has already attained, she is assured of progressive enfranchisement — thanks to which fact the child may perhaps obtain a larger portion of the protection due him. However, there is one thorny point at which my faculty of prevision collides with the barrier of the inconceivable. That point is the too real contradiction between the ideal of monogamy and the striking fact of an empirical polygamy so deeply embedded in our manners that no one can maintain in good faith that it is declining.

So far as legal polygamy is concerned, it necessarily implies the enslavement of the woman, along with despotic excesses such as are sanctioned by the religious law of Islam. In Christendom, no one can say that actual polygamy has increased, since the evil has always attained a degree of excess which cannot well be surpassed. Not only is there nothing to show that we are making any advance in this respect over the people of antiquity, but everything plainly indicates that the last veils of hypocrisy have long been cast off. Things being as they are, to pretend to expect from moral precepts — whether religious or not — a human reform of which no one can see any precursory signs, would be nothing but an act of voluntary self-deception which could in no degree change the facts. Man lightly accords himself the right to practice polygamy, yet denies it to the woman under penalty of a loss of social standing, on the comparative value of which men and women, if they were frank, would have much trouble in agreeing. Ninon, who was a philosopher, and who, if we may believe a certain avowal of hers, had little sensuality, chose to adopt the moral code of men. Not every one has the wit so nearly to escape the consequences of a step so dangerous.

At the present moment, I see no sign of the beginning of any social evolution which will lead us away from universal polygamy, practiced especially by men, to the vir-

tuous practice of a general monogamy, which is the ideal of woman. If man is to remain polygamous, must woman necessarily throw herself into that perilous adventure? In the common interest it would be preferable that she should as far as possible be spared the risks of falling into decadence. It is much more worth while to see her aspire too high, even without sufficient warrant than by force of example to reduce her to the extreme of degradation.¹

I have spoken of woman, notorious example of weakness, because — so far as she is concerned — the abuse of masculine power is evident even in civilized times. In view of the admitted inequality of individual capacity, due to organic evolution which in each case is differently determined, it would be necessary for the peace of men's souls that the weakest should always be wrong and the strongest always be right. That would be reassuring if the rôles were not sometimes reversed. He who has had the misfortune discreetly to abuse his power will, with good grace or bad, some day recognize the cruel resignation with which his victims are reduced to clothe themselves. Inevitably he will hear an appeal to the justice of men and of Heaven. Alas, the gods are deaf, and the judges, being men, let themselves slip on the same declivity as the gods.

The objective world knows no justice. It is a contest of forces in which the powerful necessarily conquer the weak. We must adapt ourselves to this fact, and we must seek in each case so to manipulate the forces as to bring them nearer to a transient equity. For that very reason human justice is all the more precious to us, though it affords us only momentary glimpses of relative truth.

On this point Pascal said and repeated some profound words: 'Doubtless equal division of property is just, but as man is unable to compel obedience to justice, he has contrived that it should be just to be obedient to force, for the purpose of identifying justice with strength and of establish-

¹ I am forced to admit that the birth of a baby impels man toward polygamy and woman toward monogamy. There can, it seems, be no improvement except through the reform of the husband.

ing peace, which is the sovereign good.' No one could go farther in the analysis of our present social order. Whether with their eyes shut or open, conservatives, revolutionaries, and reformers will in all sincerity have to subscribe to it. Even modern man has been unable to do more than heighten the picture, for he has demonstrated that this peace, the 'sovereign good' of Pascal's philosophy, is, thanks to universal competition, only a battlefield where the hand-to-hand struggle never ceases.

What remains? Justice and force, face to face. How shall they adapt themselves to each other? Pascal sees the truth and utters it with brutal candor, leaving our hoped-for justice in the iron grip of causality. Whether or not he wins his bet in respect to the intervention of a Divine Power, is it just that, for their happiness or their misfortune, some are born into the world, whereas others wait, and will continue to wait at the gates of an indeterminate consciousness? Is it just that some are born lower in the scale of animal life, only to be victims of those of higher grade and to make victims of those more lowly than themselves? Why should a living creature be born a mouse rather than a cat, a human being rather than a lion? We must wait for death to settle the account, not with an arbitrary Master, but with Infinity — which is the same as stating the problem whether there be a God or not in terms which make impossible any provable solution.

Pascal, tortured by his own logic, is only too right. Force is the law of the universe. It implacably determines the outcome of every conflict. How could this cosmic domination, from which nothing can escape, be subject to the transient, subjective justice of man, which varies according to the emotions of the moment? The individual invokes the ideal of justice as he invokes the ideal of freedom. We have seen that his freedom resolves itself into an unconsciousness of the fact that his organism governs him. His ideal of justice will turn out to be an adjustment of forces brought into equilibrium in the varying measure of each sensibility. The definition is self-contradictory. Since

movement is merely a sequence of connected forces out of balance, complete equilibrium would inevitably bring the movement of the universe to a standstill.

Force and justice, then, are two terms which cannot have even a bowing acquaintance. Individuation, the constituent phenomenon of our subjectivity, is an apportionment of unstable complexes that (like all cosmic phenomena) tend to a stability which they never attain. Subjectivity, on the other hand, is merely a ray reflected from the objective Cosmos on our sensitive nervous surfaces, and our organic unconsciousness of the phenomenon is what allows us imaginatively to separate our Ego from the surrounding elements and thus to set up a temporary personality which it is our ambition to make permanent.

That does not prevent us from seeking to establish among ourselves, if not among all living creatures, a condition of approximate justice, although perfect justice is impossible of realization. Indeed, bearing in mind the increasing discoveries of ways of accommodation, everything invites us to make the attempt, if we have the force to impose the complexities of our justice on the advocates of measures differing from our own. Pascal, then, was clearly right in seeing in our justice nothing except a manifestation of force, just as our very freedom, which gives us the sense of independence, is the result of opposing forces, consciousness of which escapes us, but which, nevertheless, exercise a direct control over us.

I keep on repeating that the only solution is to adjust ourselves. That process presupposes a development of knowledge through which we shall succeed in making 'nature obey us by obeying nature.' Generally we lack that courage which nothing dismays, with which to compete in an apparently lost game against that impassive player whom we call the Unknown. To be sure, the day may come when we shall claim the privilege which our acceptance of life confers. But suicide rarely results from an attack of philosophy. In utter despair it is enough that the measureless peace of the unconscious Cosmos seems a more certain

refuge than the greater injustice of Paradise for some and of Hell for others, for which neither have asked. Furthermore, some people quite plausibly assure us that a life analogous to our own is bound to exist on other planets throughout infinite space and time. To promise justice to the whole universe seems a bold undertaking. How can we fitly qualify the dream of fulfilling such a promise?

Naturally, ideology plans to replace divine injustice with less iniquitous forms of human injustice masked behind high-sounding names. We must praise the attempt in whatever measure we fall under its spell. Life passes; we shall have tried.

And, again, does the Cosmos owe us the sentimental satisfaction of solving either this problem or any other? Nothing is less certain. On the contrary, the facts prove in the most ample fashion that cosmic processes are completely indifferent to the shocks which our sensibilities receive. At whatever stage our evolution shall come to rest, we may be sure that many questions will remain unsolved. In ways that concern us little, all debit and credit accounts of the activities of the universe will be cosmically balanced. That should not discourage individual and social reform, whether undertaken for our own special benefit or for the general good. To attempt to bring about proportional adjustments to the universal order seems an ample task for our brief lives.

Our pleasant-sounding 'reforms' meet opposition not only from those who profit from abuses, but from those who are sunk in the apathy of atavistic habit. The Marquis d'Argenson, speaking of a nephew of Fontenelle, the Intendant of Aube, who had just been recalled for having attempted some just reforms, thus epitomizes the history of many well-intentioned reformers: 'No use could be made of him in the superintendency of Caen, because at the very start he made himself an object of popular abuse. He was unwilling to heed the fact that, until a better day shall dawn, it is customary for all those who are near the throne¹ to

¹ Read: *De l'Autorité de tous les temps*.

share in unjust favors. He wished to act the prompt reformer in respect to particular details. . . . He wanted to change the customary allotment of arbitrary taxes and especially the poll tax. As always happens, those whom he relieved gave him no thanks, for they thought that what he had done was mere justice, and those whose tax he increased raised such a clamor, wishing to kill him, that the welkin rang with the reproaches that beset the throne and the court. He was regarded as a bad intendant, because he was too good a one.'

What matters the name of the government? Human nature prefers the accustomed rut to a bothersome change. Hence, profiteers and their victims too often agree in supporting the evil at the expense of him who perseveres in the work of reform. Such is the principal foundation of our 'progress' in civilization. Chance favoring, by dint of continual effort, the principal oppositions will perhaps some day be overcome. The 'reformer,' though statues of him may eventually be erected, will nevertheless have had his bad days.'

So far as what is known as 'the social question' is concerned — that is, the problem of equitable remuneration for all labor — matters progress in much the same way. Whoever obtains a just division often sees in the fact an encouragement to ask for more, without always taking the general interest sufficiently into consideration. The workman obtains leisure more easily than he learns how to use it. Social peace will come of itself when economic groups strong enough to command justice for themselves are able to succeed in curbing their ideology for the sake of the victories of a progressive altruism.

Let us recognize that progress in civilization cannot escape difficulties of infinite complexity, in the course of which basic organic changes are sometimes replaced by merely satisfying appearances the advantage of which is only a matter of words. Notable progress has been made, and even greater progress has often been prematurely discounted, while atavistically people tacitly agree to revert,

¹ Ibsen: *An Enemy of the People*.

under cover of a noisy idealism, to everything which public hypocrisy can conceal behind a false front. If the strong would undertake to live like Christians — that is, in literal agreement with the words of their Master — for the whole of one day, they would be surprised to see how the world would be changed. And yet, progress will be less a matter of the formulæ of a new idealism than of a smaller discrepancy between preached and practiced idealism.

Far from considering that as discouraging, it seems to me rather a reason for persevering. Must we not measure the obstacle before we attack it? A sanctimonious optimism can lead only to Oriental fatalism. A bitter pessimism can lead only to the ultimate repudiation of energetic action. A good social doctrine is one which keeps us in a natural succession of disinterested activities. Therein lies the crux of the evolution of a civilized conscience whereby our life would be completed by the wonder of discovering that we were living in a manner different from that to which we are habituated.

Since it is impossible for me to enumerate all the forms of social activity which, as factors of civilization, coöperate or contend, I shall limit myself to brief remarks from which the reader may fill in the rest of the familiar picture.

Merely as an item in the account, I mention the problem of individual accumulation of wealth, which has so greatly exercised the minds of men. The troublesome problem of *mine* and *thine* came to the surface when social contact between the strong and the weak first began. So far, the fact of polygamy, like the fact of war, has brought us face to face with elements which cannot be altered. It is the same with the individual appropriation of land (the result of an exercise of force) for the benefit of a propertied oligarchy which dominates a more or less enslaved peasantry. The equal division of the soil among individuals is a problem which must continually be taken up anew — to the interruption of cultivation, not to speak of a permanent inadequacy of results. Ownership in common, the chief ideological solution, would end in enervation and in the

suppression of all initiative.¹ The point will have no weight with morons and orators, but nothing forbids our thinking that little by little we shall reach an approximate solution.

In any event, the time seems to have come for us to understand that action and reaction cannot be separated, and that all rational procedure applied to the industrial appropriation of land may be beneficial or detrimental to the community as a whole, according to the way in which it develops. Why should we bar the path to the free exercise of initiative in the hope that irresponsible functionaries will be able ideologically to make a better use of the land than individuals who have a direct personal interest in it? Social success lies not in any automatic mechanism that diminishes the individual, but in the sound regulation of human energy. Personal ownership has already undergone innumerable transformations and will doubtless require many more. It has already found an excellent counterbalance in powerful unofficial organizations for collective bargaining, which are far more effective than they could be under the pretentious irresponsibility of the State. Let us throw a veil over the weakness of a loud-mouthed social power which, affected as it is by influences wherein the sense of public interest is not always dominant, is not uniformly successful in governing itself. It would not surprise me if in the course of ages and with the advance in universal culture, the state should by degrees ease itself of the load of organizations which do not directly need its intervention. The inadequacy of public control, as demonstrated in the functioning of our political activities, must hasten a movement for liberation in the common interest, provided a close oversight of all corporations having a public responsibility can be conscientiously exercised. Of all the idols which have so grievously oppressed us, not the least cruel has been the State, under its many vainly changed masks. The problem remains one of the intellectual emancipation of the indi-

¹ Consider the defects of the Napoleonic administration of which we are so proud — multiplication of functionaries and apathy on the part of the citizen.

vidual and the quality of the development of character of which he is capable.

AUTHORITY, LIBERTY

I know very well that according to classic custom, I should define 'authority' and 'liberty' before discussing the phenomena that the two words are supposed to represent. These words indeed express no more than subjective states which have no significance except as they affect the human race. There are necessarily in the world syntheses of energy that regulate phenomena. One is the authority of the gods which, suited primarily to the primitive mind, some people strive in every way to extend to the present time; another is the authority of cosmic law as positive science has defined it — it being understood that this law is nothing more than the expression of relationships which have been found to be constant.

Since the remote origin of human groups brought together under the empire of different sentiments, men of every degree of intelligence have successively exercised their wits on these two formidable problems, always propounded but never solved: authority, liberty. One cannot conceive of an organization without any directing executive power. If we are not to be a band of slaves, every member of a human society must retain a portion of liberty. The whole difficulty lies in knowing where to place the varying limit of that share of liberty which should necessarily correspond to the successive stages of individual development.

To maintain order, without which a productive life is impossible, we must in some way agree on a body of domestic laws, and even on laws concerning international relations, were they only for a provisional show of security. Alas, we have to-day more 'principles' than we know what to do with. We are forever calling upon them. All that remains is to apply them. In the name of every form of government we have boastfully proclaimed them, that is, we have paraded them in our speech, but the results have been far from our expectations.

Far be it from me to decry 'the law,' which is our safety-anchor. And yet every one will agree with me that the value of 'law' is less in its written form than in its application. Why is it, then, that most men had rather praise texts than practice them? The 'law' is the fundamental constituent of the social life of individuals and of groups formed to promote public or private action favorable to their interests, which in part are the interests of the public at large. That is the reason why our revolutionaries are right in seeking to base social order on respect for 'the rights of the man and of the citizen,' with a view to particular and general adjustments which make the framework of the nation. The difficulty is that the finest principles are of no value whatever unless they are equitably applied. Any one will doubtless concede that the 'right' to be guillotined without even being able to defend yourself was not perhaps one of the rights the acquisition of which seemed the most urgent. That represents the abyss that separates ideology from hereditary empiricism. The conception is precious; its embodiment in action is no less so.

That form of 'liberty' which requires us to put our trust in the man capable of self-government has long been popular. The prestige of that liberty has perhaps decreased now that it has been accorded us, or that we are able to take it at will. If we reflect on the matter, it is a formidable undertaking to live *free*, that is, to be in position to govern ourselves without at the same time infringing upon the liberty of others. Every one talks glibly of this excellent theory as of one easy to put into practice; few appreciate the restrictions that *each one of us* must place on himself if he is not to make himself unbearable to his neighbor.

By way of realizing the enchanting abstraction we have, according to our ancestral method, invented an abstract entity, the Goddess of the Red Bonnet, who makes us hope for the best by promising to perform a miracle on the morrow. The great trouble is that that to-morrow never comes. That goddess has done good, and she has done evil. Such is the common lot of ideas that must run the chance of human

realization, when we are summoned to subject ourselves to the test of an ideology which will be delusive in direct ratio to the beauty of its formula. The greater that beauty the greater is the likelihood that it will elude us.

Much the same is true of 'equality.' Certainly all citizens should be equal before the law, and so they would be if actual practice gave what theory promises. It is equally true that biologically men are unequal in terms of their capacity, which depends on the action and reaction of the circumstances that mould the individual. To make equality of treatment rise out of an inequality of makeup is a task all the harder because our whole nature conspires to make us demand the maximum from others and to give them the minimum ourselves.

As to 'fraternity,' the practice of it since the days of Cain, who made a bad beginning, has not always been easy. Since it was written that man should incline to murder, what temptations assail us from every direction! Thus, at the very start, we saw what contradictory sentiments may be hidden behind that atavistic name of 'brother,' which is, alas, so often put to bad use. That is why our revolutionaries, for every one's good, took care to end their formula of fraternity with these simple words: *or death* — which should turn us aside from violence toward others by the fear of that social *lex talionis*, the sanction of ancient savagery.

As a last resource we had the Roman jurist with his inexorable law. Formerly we had Manu, vice-regent of God, who punished an identical crime with an increased penalty if it had been committed against a member of one of the higher castes. It was a primitive notion of a 'right' to unjust privilege.

In our Revolutionary trinity — liberty, equality, fraternity — we seemed to have at last the key to a higher social order capable of meeting all the conditions of organized social life. *Forum et jus* — just laws and just judges, with the right of each to defend himself — were what the Romans demanded. The Emperors showed that the human conscience could be treated with impunity. We have 'constitutions,'

and rigorously severe laws guaranteeing 'liberty,' and in Moscow, in Rome and in Madrid every one is boasting of having thrown them all into the Barathron of history. Nobody seems to give the matter any attention unless it be to acclaim the renewal of an old régime of violence.

We have treaties. And Germany, when the test came, after having asserted that they were mere 'scraps of paper,' promptly finds 'statesmen,' victims of her repudiation of her sworn faith, ready to excuse her with ideological conventions to which each of them seems to attach a ridiculously great importance. We have codes with whole libraries of commentaries and judicial decisions, together with all sorts of methods of reform learnedly provided for. Under the eyes of the public what becomes of the theoretical right in actual practice? *Coups d'état* and revolutions succeed one another, and at certain times public opinion avoids defining itself lest it discover what it really is.

The only example of true liberty is the Divinity who, tormented by our importunities, is supposed to devote himself to fulfilling our mediocre prayers, thus complicating divine liberty with a human liberty incompatible with it. In dealing with the relations between Divinity and man, the imagination has found means of lending itself to every fancy. It required laws to regulate the relations between man and man.¹ The value of human laws depends directly on the intellectual capacity of those whom established power has temporarily made legislators. Humanity has only to obey those laws under the threat of penalties made and provided. It is for each one to judge which of the evils that he is exposed to is the least. This privilege of choice, practiced according to the capacity of the individual, is what is called 'liberty,' and that 'liberty' makes the individual responsible and gives him dignity. The authority of the state, whether a concentrated or a diluted tyranny (in the antique sense of the word) openly modeled on divine power,

¹ These laws are the utterances of force; they are established by custom and made permanent in regulations which are more or less equitably conceived and applied.

must necessarily regard the free man as its enemy — a fact from which in the earliest times sprang that eternal struggle which will end only with humanity itself.¹ Born of our loquacious inadequacy, our liberty necessarily produces faulty results. We are well aware of the fact. The mistake lies in looking for a fixed standard, since from day to day the evolution of the individual qualifies him for new activities and requires the setting up of a power sufficiently flexible gradually to throw overboard empirical baggage that it no longer needs.

But since the development of human activities always brings a new complexity of function, it continually calls for new forms of social intervention in which the use and abuse of the most legitimate authority are so closely akin that they are at first hard to distinguish. The line between right and might shifts in proportion as the individual evolves. Whether the legitimate rôle of authority should be extended or curtailed is no longer a matter of metaphysical discussion. Evolution, the civilizer, never ceases to imply an evolution of needs that day after day exact new adaptations not only of the individual but of the coördinating powers. This condition is responsible for contradictory and yet simultaneous inclinations both to extend and to curtail the field of authority, that is, the scope of public intervention in the activities of the individual. Since man is actuated by determinate laws, the field of the forces of the social complex is always shifting, and from that fact spring the slight, ever-changing differences in the relations between authority and liberty.

Any scientific doctrine attempting to deal with the changing relationships of public and private power would be confronted with very different problems according as the ages treated were those of passive submission or those in which men fought to the death either for or against 'liberty.' At the price of the noblest blood we have won that liberty

¹ The reader will notice that we are not here concerned with the philosophic freedom of living organisms, or with the determinism which conditions its exercise. The question is simply whether man, such as the Cosmos has made him, can be left to the natural tendencies of his individual evolution.

from the champions of dogmatic and civil oligarchies, and we have already served a long apprenticeship in respect to the enlightenment and culture of the individual. However, we must admit many and serious failures. The reason is that we are always confronted with those visions, the substance of which is mere words, but in which ideology delights to the point of forgetting facts. What a fuss we have made over obligatory primary education! No one now pays the slightest attention to the matter. Is that because the reform has been accomplished? No. Ask any one what is the percentage of illiteracy. No answer will be forthcoming. On the other hand, you will hear much talk of 'a unified school system,' though even the most 'learned' cannot say exactly what form it should take. Doubtless, there is a common foundation for all education, but the more knowledge increases, the more teaching will become specialized.

The same applies to the enjoyment of 'liberty.' Many heroes have stoically accepted the worst tortures in order to conquer for us the right of free thought and the right to express ourselves without restraint on all questions relating to man in process of civilization. That glorious privilege is now ours. Are we sure that we have used it as those many martyrs hoped that we should? Be cautious, reader, when you compare the promise with the result. The first obligation of a free people is to accept the responsibilities of public life. A people that in the apathy which follows violent exertion drifts aimlessly with the current of the moment merely proves that it is easier for a nation to conquer liberty than to enjoy it.

Since group evolution is a compound of the evolution of individuals, all social phenomena come down to those adjustments between words and deeds which lead the emotional crowd to hasty decisions based on a 'public opinion' as unstable as a feather in the wind. Haphazard formulæ fly from mouth to mouth amid enthusiastic approbation or strong disapproval. We speak of the 'will of the people.' To-day the people wills a thing with all the more violence because to-morrow it may not will it at all; its interest may

decline to the point of indifference and even to the point of denying that it ever willed it. Eager to obey the irresponsible crowd, the leaders proudly follow the rank and file. A flood of 'commands' rolls by, another follows, and the ever-shifting spectacle is constantly renewed. By definition parliaments talk, yet action, if it ever comes, will probably come too late. Meanwhile, the prophet who set the 'organism' of public decision going discovers that it is a far cry between an idea and its realization.

The ideologue does not perform miracles. Very fittingly he confines himself to the deceptive charm of the realized abstraction. In it he finds as much hocus-pocus as he put into it and concludes that some day his formula will sweep humanity off its feet. To bring any idea to realization it is first necessary to carry conviction — at least to the unstable majority. That process requires many theses, many controversies, many debates. Inevitably it will meet the resistance of the atavistically conservative and of those who are ambitious of the absolute in which dreams lose themselves. Halfway between knowledge and jumbled misconceptions, the public is eager enough to understand, yet frequently finds that it has not the requisite capacity. Consequently, it acts on faith rather than on a comprehension based on experimental data. Its affirmations savor of the catechism rather than of the laboratory. What, then, are we to say, and what are we to do, if we want it to act?

The conduct of organized humanity requires brains, and, furthermore, educated brains. The right kind of temperament is equally essential. You wish to persuade, to overcome resistance, to impose your will in virtue of a heroic endurance, and you encounter every form of accusation and every degree of hatred with all their consequences. Is it not a task to make any man hesitate? The man of action, who is not always a man of ideas, will, however, make his decision. What then! We are not concerned here with an army at maneuvers. It is rather a matter of obeying when it suits you, that is, something closely resembling anarchy. If a man is defeated, he must eternally renew the struggle. If he is

victorious, his victory is most embarrassing, for victory carries with it the obligation promptly to begin to convert promises into practice; it implies the danger of chilling, if not even of destroying, the enthusiasm of your companions in arms; it implies the risk of uniting against you all the opposing factions and the danger of justifying every treason and of exposing yourself to every insulting judgment.

The worthy members of the Constitutional Assembly of 1789 proceeded ingenuously to read from the rostrum a page of Montesquieu or of Rousseau, and when they found that that course did not advance matters, many of them silently betook themselves home and left the field free to the future deputies who were in a fair way to sharpen the sword of their ideology. Montesquieu and Rousseau embodied the ideal which satisfied popular hopes; they had developed the ideas necessary to put the emotions of the times effectively to work. Action, however, calls for discipline, patient persistence, and the energy of great resolves tempered, if possible, with tolerance and with fairness. There was no response! The brutality sanctioned by atavistic habit was ready to solve every difficulty, to make man over by means of new 'slogans' while keeping him to the work of violence which it had clearly promised to suppress. The only result was in the end to give free course to that reaction of fatigue in which first great thoughts and then fine words founder.

Far from exaggerating the picture, I force myself to attenuate its most grievous aspects. Nothing is farther from my mind than to discourage the general hope. But when an ideology which seeks good through subversion has failed so often, how can we explain that general lack of success if not by the numberless and measureless obstacles piled up at every turn of the path which leads from the ideal to its practical application?

The 'ideal,' which is an emotional lien on ideological anticipations, has the inestimable merit of inciting us to action. Our misfortune lies in the inevitable offset of an inevitable disappointment. Even if right feeling accompanies right thinking, even if men come to understand that **they**

must be content with a partial realization for the sake of a provisional social readjustment, the impossibility of creating in the masses continuous, united, and orderly action explains only too clearly why, from antiquity to the present day, the same questions present themselves in eternal debates and never seem much nearer definitive solution. The attempt to inspire in the masses a short-lived community of opinion excites so much opposition that we cannot succeed within any calculable period of time. The traditional oligarchies of rank and fortune we have been able to destroy. From their cinders have sprung up new oligarchies lacking that prestige of age on which the power of the originals depended.

Under every régime, as La Boétie dared to say, the people alone is judge in its own case. But what is the people? Even if it can gather the essentials, how can it pronounce an honest verdict? And what guaranty have we that putting that verdict into execution will not be systematically delayed, or misapplied? The gap between the triumphant doctrine and the empirical extravagances which are so prevalent to-day exceeds any measure that we have. Each one of us is quick to recognize the people as the final arbiter, but only if it can be induced to speak. I need not describe the means. One has only to look about. I touch on the matter the more lightly because, amid the hurly-burly of the passage from thought to action, the value of the guaranty that the verdict, even though its entire honesty is assured, would be put into execution would perhaps not be sensibly increased. The public as a whole may be deceived as well as the individual. Irrespective of where we seek elusive truth, only the future will supply the test that will establish it. And for how long? To-morrow will repair the faults of to-day, unless indeed it aggravates them. In the case of governments which try to give effect to some special doctrine, the offset to mistakes and to the discords arising in half truths is sometimes so small as to prevent all progress. Whatever happens, there may still remain a possibility that though our plan is imperfect, we can still make shift with it.

Ideology wants institutions which adhere strictly to the theories it has formulated; and the great reformers have not failed either to propose or with the aid of revolution to entrust these institutions to the hazards of practical application. We are beginning to be able to pass judgment on the results. After the final test which Russia has applied, the problem of absolute monarchy seems to be settled. But the disappearance of monarchy, even in the Far East, brings up the formidable question of self-government according to the methods of empirical utilitarianism. Man has reached the point at which he *ought* to govern himself. Can he? Have his attempts been successful or unsuccessful? How is it conceivable that his beginnings should not be inadequate? The Greek people, the most intelligent in history, with its tyrants, its Demos, its sycophants, made a pretense of governing itself by means of deliberative assemblies. Alexander enslaved it, and Rome crushed it after having pillaged it. Every one knows what Cæsar and Augustus made of the Roman Republic. Napoleon, in order to make an end of the French Republic, followed their method as closely as he could. After war and revolution had brought the French people back to representative democracy, the experiment, as it would be idle to try to conceal, has not produced the expected results. In England, the hatred of ideology has resulted in an empiricism the coördinations of which are rough and uneven. I am careful to draw no conclusions at the present moment. More than any other, the social phenomenon needs time. But how can any one fail to observe with what facility certain countries, among which I do not yet wish to number France, seem to discard the ideas for which under their own auspices the best blood of Europe has been lavishly shed?

I hope no one will impute to me an undercurrent of skepticism. I have often happened to see decisions, reasonably regarded as sound, come to nothing, because those who urged them with the greatest energy could not command sufficient coöperation to make them effective. The fact has sometimes made me distrustful of good intentions, without

giving me any faith in the other sort. I do not wish to deceive others; why should I be willing to deceive myself? If I cannot always reach the conclusions I should like to reach, at least I have the resource of recording my experience in the hope of affording to others a way of obtaining consolations which I missed.

I believe that I have said enough to make it clear that in this connection the words 'majority' and 'minority' are no more than an empirical resource in the general nature of a calculation of probabilities. By showing us in a definitive way that majorities cannot be made up except through the agreement of men of inferior mental power,¹ Dr. Le Bon has enabled us to explain the mediocre results obtained by majority-government.² I am aware that in decisive moments outbursts of noble emotion can later correct such errors as are reparable. But the finest emotions are short-lived, and the errors of yesterday united with the weaknesses of to-morrow go to make up an account the total of which cannot be determined. Amid a tumultuous and often contradictory confusion of feeling, thought and action, our organic evolution will occasionally permit us to catch transient gleams of a tangible progress in our civilization. Of them we are ingenuously proud. From that point of view, even after so many errors, our ideology — that is, the pursuit of an idea without regard to the facts of life — is valuable to us, for we are beholden to it for the disinterestedness which carries us out of ourselves into the resplendent phantasmagoria of the unknown.

It is too much to expect that the earth, once we get our feet on it again, will not somewhat spoil that magnificence. It is obvious that the ancient stamp of atavism is not easily

¹ It fits, moreover, into the rhythm of things that majorities break up when they are in power, whereas minorities, when worthy of the name, are maintained and strengthened by opposition. Nothing is more demoralizing in the case either of majorities or of minorities than the understandings (open or concealed) reached by persons with common interests for the accomplishment of special ends.

² There remain, for purposes of comparison, the disorders of absolutism. They produce revolutions, which, because of the complexities of discontent, prove contagious and pass from people to people.

effaced. Who is sufficiently benighted to wish wisdom without a grain of folly? Everything considered, we can without too much shame contemplate the path we have traveled through joys and sorrows. Indeed, we should not, perhaps, complain, even though our phraseology must always remain finer than the reality. We owe it to ourselves, however, not to forget that only deeds accomplish results. The balance between authority and liberty gives us the sensation that their rhythm makes our destiny. There can be no civilization without a basis of hope, and the measure of that hope is the measure of our liability to disappointment.

Of governments which undertake in varying ways to arbitrate between the social order and personal freedom I have but a word to say, for our approximate civilizations accommodate themselves with remarkable ease to every sort of label, whether intended to designate similarities or differences in fundamental tendency. Autocracy and democracy derive from totally opposite conceptions, but generally resolve themselves into oligarchies which group themselves around a monarch or a thousand-headed Demos, and for which are substituted popular oligarchies with results that have not much changed since the day of Aristophanes.

I pass by the sickly chatter of the so-called representative system, better fitted for incoherent words than for coherent action. I willingly risk the aphorism that parliaments are not fit to govern — for reasons which practice has made sufficiently clear. In too many countries the art of governing has become the art of postponing. The reason is simple. We resolve that to-morrow we shall be firm and energetic. Deliberative assemblies, however, might have value as instruments of criticism if they would only impose on themselves the duty of criticizing. But there are so many ways of dodging that duty — both by those criticized and by those who criticize — that a compromise is only too often reached on the basis either of postponing the most pressing problems or of agreeing on plausible formulæ which are subjected to no real criticism.

We are bound to believe that, civilization aiding, these

weaknesses will some day end. Parties and parliaments generally have excellent, but not very vigorous intentions, yet, since they cannot contend with elements that are stronger than they, they can bring nothing but scattered and ineffective effort to bear on questions the solution of which requires a firm coöperation of wills. At long range, the aristocratic oligarchy seems better to respect appearances. Other forms of government talk more noisily, but do not offer us the promised compensation of a superior social disinterestedness.

In principle, all governments want to do the best that is possible, if only with a view to remaining in power. As for deciding what that 'best' is and choosing the methods to obtain it for us, their generally confused efforts too often lead us into a blind alley where further progress is blocked by combinations of interests. However qualified, governing oligarchies, duly provided with idealistic phrases, remain founded on the satisfaction of social interests which demand all they dare in excess of what is properly theirs. Up to the present, democratic oligarchies do not seem destined to escape the same fatal limitation. Incoherent as they are, Fascism and Sovietism, simple governments of brute force, the principal characteristic of which is their lack even of a theory, show what a degree of intellectual confusion a people in the hands of a popular oligarchy can reach. However, according to modern teaching, evolution by *quanta* of energy goes on in rhythms of elementary forces, sometimes accelerated and sometimes retarded. Expecting they know not what, government and people, reacting on each other, form for themselves the institutions which chance dictates and in which under new names will be found unspeakable regression to the incoherence of the past. Man as well as his planet is shaken by earthquakes.

When we consider the course of history throughout so many sanguinary upheavals, is it not encouraging to think that even after allowing for the proper proportion of disappointment, sums of happy realization can doubtless be obtained from future forms of social organization? For all

governments have a tendency to develop their ideals, no matter how much embarrassed they may be by coalitions of conflicting interests. Autocracies and their oligarchies are hopelessly bankrupt. Under varying forms, democratic oligarchies are at the present time generally on trial. To the abuse of personal authority they still offer the contrasting abuse of an irresponsible anonymous exercise of power disguised under the name of responsibility. There is an evolutionary rhythm, the period of which is unknown, and during which those patient efforts are prodigally exerted which short-lived man owes to developments the issue of which he cannot foretell. Only the test of time will establish the value of the efforts which we base on our empirical theories, and time will not consent to be shortened to suit our convenience. Complaints, or prayers or convulsions will not change our destiny.

I have pointed out that the best government will be that which devotes its efforts to the development of the individual, who is the decisive factor in all civilized progress.¹ However, neither talk nor even the promulgation of laws is enough to produce that result. Above all, the sincere coöperation of men of good will, more apt to declaim than to embody in action the fine words in which we advertise what is most showy in our activities, is necessary. 'Practice what you preach,' is the maxim the most difficult to realize in our fundamental selves; we are too apt to stop at those common disguises which we accept in others, so that they in turn may accept our own pretenses. What we practice is an indulgent acquiescence in a smiling masquerade to which each of us brings the complaisance which his own hypocrisy requires, in the hope that others will reciprocate. Government of yourself, government of others: — these are identical counterfeits of generous dreams in which we accept payment in promises for things we have not given.

¹ It cannot be otherwise, since a compound of individual evolutions is the basis of general evolution. Unfortunately, individual evolutions cannot combine, except through bringing the general tendencies of the more intelligent minority down to the level of the majority incapable of rising above a democratic average of inferiority.

We must make the best of it. The public interest gets off cheap by counting on a ticket in a lottery of which the grand prize exists only in the posters on the walls. To struggle on without expecting any reward seems not to have sufficient attraction for the masses.

If each one of us should some day succeed in governing himself justly in all his relations, the superior evolution of man would be completed. Perhaps the hypothesis should not be rejected. Until that day we can count only on the accidental realization of ideals, or on the intervention of genius. Unfortunately, in the markets of the world, genius often costs more than it is worth. Consider Alexander, Cæsar and Napoleon and the heritage they have left us.

This is the place to say again that we demand of the Cosmos personal satisfactions not due us. The human fiction of a universal Providence is no doubt advantageous in the world. But to that hypothetical gate leading to the supreme bliss we may not approach, it seems, except in another life. We have, however, discovered that the reactions of our sensibilities, which produce our joys and our sorrows, are not taken into account by the forces which guide the universe. The repercussions of pleasure and of pain perhaps have an effect in the combinations of universal energy which could be mathematically calculated. It does not at all follow that the settlement of the account should take place in our organisms during our brief life. No one has yet suggested that the eternal carnage involved in the butchery of animals was about to be resolved somewhere in the world into a compensating felicity which, inversely, is meaningless except in terms of our capacity for pain.

If we can so easily accept the appalling sufferings of our humble fellow-beings, why should we demand on our own behalf an accounting from the universe which we have all the less right to require of it for the reason that we are not its cause but its effect? Whether we — be we men or ants — are happy or unhappy, well or badly governed, is none of its affair. On the other hand, our human individuation has gone so far that, whether for evil or for good, we can feel our-

selves to be co-laborers in our own destiny. Is not that enough to occupy the period of our planetary adventure?

To that end, I recommend one especial virtue as a means of obtaining the happy accomplishment of our individual evolution, and through that of our common civilization: I mean tolerance, which facilitates all agreements for mutual indulgence and at once enlightens and enfranchises the human mind. Up to this time we have vainly asked men to love one another. Perhaps they will not be so slow to understand the supreme advantage of tolerating one another. To aid them in that respect, it may be helpful to remind them occasionally that they form a unit, and that nothing, either good or evil, can happen to their neighbor which does not in some degree react upon themselves. Armed with these two established truths of experience, namely, that tolerance makes life easier and even embellishes it, and that our universal solidarity holds us happily bound one to another in all the accidents of joy or of sorrow, we shall hold, it seems, the two keys to our civilization. United and tolerant, we shall be human in the fullest sense of the term. The Cosmos has ample time to work out the results. The best use that we can make of our lives is unquestionably to live so uprightly as to approximate the condition of our posterity in the better future which will be theirs.

THE IDEAL IN ACTION

The reader should not complain that I do not open for civilized man any perspective of an apotheosis. There is no more possibility of a paradise on earth than there is of one in the skies. In the torrential current of things, civilization will share the lot of civilized man. Since we are no more than a sort of snapshot of the cosmic elements, our duty is to draw from our moment of life its full content of greatness in the course of centuries which, in terms of eternity, are a mere tick of the clock.

What good does it do to deny the evidence? This pride in ourselves which we so boastfully display under the eyes of the indifferent stars; this intoxication with the human great-

ness which leads to familiarity with the star and with the atom; this taking possession of the universe which so ill conceals an implacable subjection; this miracle of human culture, with its greatness and its inadequacy; this fairyland of an idealism the magic wand of which lifts us to the highest point of the infinite vault in a vertigo of disordered aspiration — all of these things, which yesterday formed an inexplicable mystery, are progressively becoming a mystery in course of being explained. The poetry of our atavistic dreams loses a blossom of its mystic crown, for our determinism holds us in a grasp of iron which cannot be broken. Dead to-day, together with his descendants, is the god who chained Prometheus to the Caucasian cliff. If we are of the Titan's blood, we must show our credentials. Born of the earth, we are also of the azure vault which, on high, perhaps displays the potentiality of something superhuman.

An impulsion toward civilization led the tribes of the Pamir to the conquest of a world of which they knew nothing. It was an impulse like that which moves the migratory bird to leave the land of its birth, drawn toward new climates in an idealistic quest of something better. How many thousands of years before the Aryan exodus had the men of the paleolithic and of the neolithic ages begun to seek an unknown stage of superpithecanthropic civilization by shaping and polishing flint to serve as implements in an industrial life the evolution of which has produced such marvels? They already had a feeling for line, and for form, since from the beginning of the art of cutting they became fascinated by those allurements to civilization — beauty of material and of proportion. Art, which in delicate investigation of the harmonies of sound, of line, of form, and of color, has wrought as many miracles as industry, is thus found to date back to the earliest manifestations of the being who was simultaneously to lead in the pursuit of human knowledge and in the realization of a dream of beauty. Who knows what æsthetic ideas about himself and about things incited the humanized Pithecanthropus to utter his harsh cries in

a scale which by degrees was to become the language of Plato? Even earlier, the automatic tropisms of love evidenced in the song of birds and even in the flowers, ardent witnesses of a fundamental excitement, marked the existence of an intense idealism.

Throughout the whole extent of the evolutionary phenomenon, the ideal of civilization is characterized by the changing incidents of our history wherein, through the path of violence, we never cease to aspire to an ultimate assuagement. The contradictory results are not so very surprising. Grandeur and decadence are the alternate beats of the rhythm of a striving for civilized life which torments, fatigues, and often discourages imaginations aspiring to nobler accomplishments.

Under the ægis of myths created in the image of its dreams, Asia, overflowing eastern Europe, engendered emotional states in which the barbarity of sanguinary rule was accompanied by a total lack of power to create anything lasting. Greece, still too Asiatic to take a permanent place either through the evolution of the effeminate and subtle Ionian or of the tensely energetic Dorian, Greece, I say, under the iron rule of Rome which it in vain tried to make more flexible in the course of its own subjection, though it influenced Varro, Lucretius, Cicero, Virgil, Horace, Livy, Ovid, Seneca, Tacitus, Trajan, Pliny, Adrian, Marcus Aurelius, and Julian, ultimately foundered in the degradation of Byzantium.

Something of Greece survives, and will long survive, in our emotions and in our most fruitful thoughts, sources of the aspirations which illuminate the rough path of our labors. Through Greece, we are We, that is, minds imbued with Asiatic idealism at grips with the rigorous demand of scientific empiricism. We pride ourselves on our ethnic ideal of civilization, but generally we are content to talk of it rather than to try to realize it. Language is a precious means of exciting enthusiasm and may in time produce in us changes that are not merely superficial but real. I cannot escape from the thought of the appalling abyss

which yawns between the teachings of Christ and the cruelties of his most ardent disciples.

Words distort things and make them appear other than they are. To me, the different states of civilized man are merely different gradations of primitive man. Whoever will not resign himself to that truth is incapable of understanding himself and, consequently, of obtaining through his own energy that will to stand erect which is necessary for his growth in height. That, indeed, is the reason why all evangelical preaching, though devoutly welcomed, does not change the worshiper, who puts his trust rather in his prayers than in the painful inner discipline which alone can overcome his rebellious atavism and laboriously make of him a new man. That is the explanation of the radical contradiction between our formulæ of life and the practices which are a crying commentary thereon. Our civilization consists of a thin varnish which is constantly cracking.¹ When, at some later and unknown time, the day of a higher conscience shall arrive (if some catastrophe does not interrupt our progress), people will be astonished that we have been able to celebrate a continuous advance in an evolution which has been troubled by so many disruptions.

We cannot easily relate the cosmic activities which our history reveals to the measure of a life which, in the vastness of phenomenology, is imperceptible. Herodotus, Thucydides, Livy, and Tacitus tell us, or try to tell us, what they had observed. Ages had to pass before we could draw from their writings any comprehensive views. The ungovernable Alexander, unable to utilize his hollow success, marked the end of the finest period in the development of Greece. The noble Pericles, who let loose the criminal Peloponnesian War and conducted it to the deplorable issue which sounded the death knell of Greece, Pericles whom the plague saved from having to drink the hemlock, sums up in a life of finely harmonious achievement the marvelous development of a history which was to have no to-

¹ Take, for example, the 'civilized' man who passes without transition from the apathy of peace to the worst brutalities of war.

morrow until it began again under the renovating power of Asiatic Christianity. Augustus, emperor and comedian, a man whose hands dripped blood, with the base compliance of the Roman people and by his own maneuvers, which were those of genius, flung wide the gates to the inroads of the most devastating decadence. The pomp of Louis XIV, a ruler whose industry was equaled only by his incompetence, and who was to sow the seeds of the bloody reaction of 1793, must be balanced against his frenzies of barbaric piety. Napoleon, quite aware of the rigors of the Russian winter, threw his soldiers into that country and passed the more promptly to Saint Helena.

All these events, brought about by the ephemeral rulers of an hour who moulded the peoples as intervals of wisdom or fits of recklessness happened to determine, and who were inspired by a varying mixture of malevolence and benevolence, form the thread of that history of fine phrases and dark brutalities in which Bossuet wanted to find the effect of a divine consistency, and in which we see nothing but the perilous cross-currents of evolution. Had Napoleon been born a few years earlier or later, the whole background and all the drama of the period would have been changed. It required the conjunction of the weakness of the Directory and the explosive power accumulated in the cranial cavity of the victor of Marengo to write the incredible story. Thoroughly fatigued, the 'revolutionary' people accepted unresistingly all the ignominies which Napoleon in his victorious madness heaped upon them. Probably when Louis XVI and Robespierre were led to the scaffold some of the crowd did them the honor of glancing at them as they passed; but if so, these same persons immediately fell back into the fatalistic inertia through which they contributed their share to an unknown task, without wondering about the sequence of the events which had led them from the Federation of the Champ de Mars to the time when the guillotine never ceased its work, and which was to lead them to the coronation of the Emperor at Notre-Dame and to the crushing blow of Waterloo.

All the splendor of which we are so proud and all the suffering over which we lament so loudly; all the courage of high nobility, and all the spurning of profitable abjection; all the faint, inadequate aspiration; all the orderly or confused activities of the people of the earth, together with all the waste of words lost in the desperately mingled torrents of good and of evil; the enthusiasm for sovereign beauty which has simultaneously inspired so many great heroisms and so many inexplicable failures; the magnificent flights of hope which end only in frightful depression; the simultaneous action and reaction of deeds of beautiful courage and of the blackest cowardice; the aspirations toward the ideal, together with all the acts of faith, and the ultimate failure of the 'great denials' branded by the poet of Hell; all the deeds of triumphant incoherence or of despised coherence; all the heroic sacrifices and all the vanities of wisdom and of folly sunk as much in the martyrology of sublime self-devotion as in the pompous displays of every infamy; the elevations without dignity; the falls devoid of beauty; all the exaltations of unmeasured ambition; all the feebleness of decadence; so much profound virtue amid so much monstrous crime; all the irrepressible conflicts in which reason and folly are tangled together; all the tumult made by speakers, protagonists of truth or of the falsehood which delights the crowds eager to entertain the facile hopes that must be paid for with the vain sacrifices of the purest blood; Athens and Rome, magnificent flashes of emotional knowledge extinguished in the Gehenna of the Christian Middle Ages; all the wars; all the devastation made by resurgent barbarism; every peace, whether made in friendliness or hatred; every rhythm of supreme kindness or of atrocious cruelty that flows on under the blessings of Providence and the sneers of the angel with the cloven hoof — all then must amalgamate, fuse, and find expression in the unity of a general phenomenon termed civilization, a thing stained with every human degradation and adorned with all the glories of noble dreams quite beyond our human measure. And yet hope remains our greatest source of energy, and the sense of the crushing

task sometimes grips us so strongly that we cannot even try to express it.

At what moment in this infinite drama can we place the original development of civilized man, and how can we distinguish him from the uncivilized man who begat him? When I go back to the ultimate sources in the Vedas,¹ I am forced to marvel at the words of a poetry and of a philosophy which bear witness to a mental effort not inferior to our own, as we must believe, since we have been able to do no more than renew it. How can any one maintain that Christianity, which is wholly modern, began civilization, when India, Persia, Chaldea, Egypt, and Greece, not to speak of China, originated and translated into ethnic action ideas of which our remote ancestors have every right to be proud?²

Did not the lofty emotion of Buddhism, upheld by bold conceptions of coördinated cosmic action the broad outlines of which positive science has been obliged to confirm, transport human idealism to heights which have never been exceeded? No one dares deny that long before Christ there flowed from it a marvelous expansion of human charity, and that it relieved an incalculable amount of suffering. People have too obstinately wished to bury in silence that magnificent outpouring of sentiment and thought which for a thousand years lighted the life of populations numbered by hundreds of millions. The reign of the great Asoka is one of the most unsullied of human glories. Even to-day its traces remain in the shape of the celebrated pillars which India has preserved in the very places where they proclaimed the necessity of men's loving and aiding one another. On the other hand, how disappointing it was when in Ceylon the Buddhist inscriptions on the rocks which still preserve them supplied me — like later Christianity — with the proof of the fall from a supreme idealism to the merely

¹ In the field of directly communicated thought we cannot, up to this time, go farther back.

² Important monuments of a South American civilization still exist in spite of the skillful Christian devastations of Cortez.

human injunctions of monks seeking to safeguard their earthly property.

Not for such a result did Kapila, the Spinoza of India, elaborate the pantheism of that Samkya of his of which Buddha received the heritage. Not for that did the sublime Chinese pilgrims Fa Hien and Hiouen Thsang in the invincible hope of conquering supreme truth accomplish the prodigies of their superhuman journey across countries in which they were in peril of death at every moment. Alas, the alternate beat of the rhythm of human relativity had to recur. The spiritual uplift exceeded by too much the modest ideal of the unconscious crowd. Buddha saw himself deified, as later happened to Jesus of Nazareth. The defeated gods of China had to resign themselves to submitting to the affront of yielding precedence to a great monk, while in India the mythic power of Brahmanic atavisms, cracking the thin shell of Buddhistic emotion, made the very name of Buddha disappear from the immense empire, but let it survive in Ceylon and in Burma, although degraded to the rank of the supreme divinity in the polytheistic dreams of the Chinese people.

However, the missions of Asoka to Egypt, to Syria, and to Epirus were to bear fruit in a renewal of Buddhistic feeling which appeared in the gospel of Christ. He, again, would have been but another vain effort if in the corruption of Rome the propaganda of Paul, who emulated Fa Hien and Hiouen Thsang, had not raised the symbols of a new hope of salvation and spread them among the disasters of the antique world. That event is only of yesterday. What sort of Eternal God is he to whom the idea of saving the world by his own decrees never occurred until a scant two thousand years ago, and who thus condemned to the infernal regions innumerable generations of creatures whom, with malice aforethought, he had caused to live only utterly to destroy them?

After a very short period of existence, during which good and evil remained inextricably tangled,¹ the time came for

¹ Good and evil have no objective reality in the Cosmos. Their existence depends wholly on our organic subjectivity.

Christ to undergo the same ordeal as did his august predecessor, Buddha. Deified in spite of himself, he had to appear before the tribunal of evolved man and show cause why we should believe in an unerring benevolent will, the idealistic power of which is already on the wane. For a long time to come supine crowds will misunderstand, Pilate will be indifferent, and Caiaphas will condemn.

Faced with the necessity of explaining why borrowings from Buddhism, as, indeed, from Brahminism itself, should be found in Christian doctrines,¹ the seminarists maintained that the ancient peoples had a presentiment of the divine truth which later faded away. Apparently divine 'Revelations,' disfigured by the mental condition of peoples who did not 'receive' them until after they had fabricated them, were not in themselves enough. There had also to be an aberrant Divinity who let slip random bits of future revelation, destined to reappear, no one knows why or wherefore, in a chaos of error. That is simply turning the historic problem end for end, and reversing the course of the ages in order to explain the past by the future, instead of explaining the future by the past, itself the explanation of the present.

How can I let myself be diverted from the historic method when I need only to evoke some moments of the miraculous Hellenism that so brilliantly took up the inheritance of Asia, the thought of which it carried to the superior development whence our modern society sprang? In the field of art the first observation which presents itself is that Phidias has never been, and probably never will be, surpassed. Does any one ask whether or not any 'progress' has occurred between the temple of Pæstum (more imposing than the Parthenon) and Notre-Dame? One is a masterpiece of simplicity, the other is a masterpiece of complexity in which all conception of unity is lost. No bond exists between the parts; it represents a number of successful efforts which have no common tie. Progress itself would be retrograde if, as some think, the ideal of art lies in harmonious simplicity.

¹ Outstandingly, the Trinity, 'Trimurti.'

One may wonder, as, indeed, I have done, whether, with the progress of civilization, war has become more or less savage. Has there come any amelioration between Troy and Verdun? Does gunpowder betoken any progress in 'civilization'? Is the carrying on of war by means of poisonous gases a laudable step along the path of civilized life? Must we, then, admit that the primitive battles fought with sticks and stones were more barbarous than were our recent 'civilized' wars, in which millions of victims fell?

Is even our peace better than that of antiquity? From the earliest times down to the present we have never known of anything with which to atone for blood but blood. As Joseph de Maistre would have it, the last word of our 'civilization' lies with the executioner. If the chatter of the courts is ineffective to remedy the murders of peace, people try to assure us, by way of offset, that the wholesale murders of war will be brought to an end by supplementary chatter in ostentatious councils in which hidden coalitions of interests are expected to produce disinterestedness. Rather should we consider the comedy of false 'disarmament' at a moment when the manufacture of arms has reached an extravagant development. Finally, I can but call to mind once again the cruelties of economic war, no less deadly than other wars, no less certain in its exhausting effects.

Without dogma and without priesthood, Hellenism attained to the heights of a poetry based on the ingenuous emotions inspired by the spectacle of the Cosmos. In the trial of Anaxagoras and in that of Socrates, the evil tendencies of their teaching on which the criminal charge was based were carefully left undefined. Aristophanes, who rallied the gods and even the politicians, makes it quite clear that in his day liberty of speech enjoyed a wide field. The high priests, not forming a distinct body in the social order, were concerned each with his own particular god and with nothing more; the priestess Theano, called on to curse Alcibiades, replied that the function of her ministry was to bless. Can it be said that the Inquisition and its stakes were an advance on that state of development?

Greece, however, victim of its orators, up to the time of Philopœmen, that is to say, not till too late, was never able to attain to the idea of a common fatherland superior to the city. The lack of that conception caused its fall when, after cruel intestinal conflicts, first the Macedonian and later the Roman came to enslave it. When Poliorcetes had dishonored the Parthenon by installing his harem in it at the time when he 'espoused' Athens in order to make the taxpayers present him with a rich dowry, no course remained open to the famous capital of intelligence but to yield to its destiny. Hellenism could hit on nothing better than making a display of its retrogression during the period of Roman decadence and of the corruption of the Byzantine Empire. It had conquered the intelligent only to be destroyed in their collapse. It was to preserve Greece from that horrible end that Demosthenes, abandoned by every one, accepted death at Calauria, where he was deserted even by his gods who in their very temple gave him up to the Macedonian.

It only remained for the barbarians to appear. From the first ages of the Church, through the dark convulsions of the Middle Ages, the long decline went on until the Renaissance of Greek thought permitted the higher civilization to resume its course. I dare not say that we shall not see other regressions. Nevertheless, after the terrible ordeal of the *auto-da-fé* of Christian governments, triumphant thought has conquered points of vantage from which nothing can ever dislodge it.

Take up, then, O man of the quaternary age, your good stone axe, which perhaps was not thought worthy even of a name. Though still unable to know anything of yourself, go, throw yourself boldly into the perilous jungle of life, and clear away the approach for that coming civilization to which evolution impels you, but which you will never see, and which will long persist in ignoring you. Your joys will be brief as the lightning flash, and your long sufferings will give you no respite. You will not be able even to suspect to what achievements you, blindfolded, will lead a remote

posterity which, calling itself 'civilized,' will arrogantly regard you as a savage whose very acquaintance is undesirable! Instinctively create your personal nobility from your profound influence over a future at grips with an inexorable universe which promises everything and passes on, having given nothing better than a fleeting dream. Lift your head toward that sun which, to the proud satisfaction of your ancestors, caused them to become erect. March toward the light of the blue vault as a prophet to the conquest of a promised land that he is destined never to behold. I, who am born of you, who am nothing, and who will soon be resolved into dust, bid you to the fearless sacrifice of your 'savage' dreams for the sake of an ideal of far-off 'civilization' which your vain descendants will fill more with words than with deeds. Surely it must be that from the remotest times you have felt burning within you a flame of 'idealism,' since it was your lot to lay the foundations of our enlightenment.

What I revere in you is the wonderful force of nature which needed no fictions to prompt you to an effort beyond your capacity. I envy you your good fortune in having escaped through the talisman of your dumbness the hallucinations of hollow words. I know nothing of you except the fragments of your skull which I have seen in the show-cases of museums. Those fragments tell us what we principally need to know about our ancestors in order to rid ourselves of false genealogies. You are the 'uncivilized' man in whom 'civilized' man should recognize his ancestor, as the proudest feudal lord had to recognize the ancient founder of his line. By your very look you bring us back to the cosmic laws of descent, and you make us discard the fictions in which our ignorant vanity was wont to expand. The magnificent stage-setting of our civilization has not failed to deceive the actor, spectator of his own comedy, as if the courage most difficult to attain were that of merely seeing ourselves as we are. Our imagination doubtless permits, and even requires, a touch of illusion, the function of which is hard to gauge. Our littleness must not infer from it too

many advantages. Let us be all that man may be, even at the risk of willing more than it is possible for us to achieve.

By your means, father, the elements of things are brought down to their actual proportions. In your august company we once more find under our feet the solid earth, which failed us in the empyrean. You bring us the correct measure of our existence. Like the paternal ghost recalling the forgetful Hamlet to his duty, you have sustained us by your presence in those perilous days in which the divine chimera had drawn us too far from the solar orbit, even beyond Hercules. The time of the great ancient errors has perhaps passed. It is also possible that other errors will succeed them. Sometimes, helped by your example, I have found myself capable of patience.

What is, is; and of that which is, I am. I am somewhere an atom of a transient something. Over other incidents of the Cosmos I have the advantage of feeling and of knowing what happens to me and of reasoning on positive data so as to attenuate my sufferings and those of my fellow beings by obtaining for them, if they show themselves worthy to learn, brief flashes of happiness. The true 'civilized' man of all periods and of all countries is he who knows how to conquer himself and so to order himself as to devote always more and more of himself to the task which exceeds his strength, yet who expects nothing either of gods or of men.

CHAPTER XV

AND HEREAFTER ?

THE END OF COSMIC EVOLUTION

AND AFTER ?

After what? Where? When? It is by no means surprising that in the cycles of the cosmic drama the various scenes do not harmonize with relative human tastes, which must endure and cannot govern. This thought is upsetting to the rank and file of mortals. They cannot dispute the results of positive science, yet they are disconcerted to think that there exists a series of cosmic scenes, without beginning or end, in which man's insignificance is adjusted through objective relationships to a transient and glorious subjectivity. Objective — the nothingness in which Pascal was overwhelmed; subjective — that in which he showed his greatness. From this antinomy resulted that outburst of theological emotionalism which solved the problem through the intervention of a *Deus ex machina* whose task it was to bring the absolute down to the measure of our relativity. If you will give me an almighty power which rules infinity with special reference to the human atom, I as well as any one else will make you a paradise and a hell move on a stage of which the footlights are astral fires, and the climax the apotheosis of sovereign good and of supreme evil.

As the drama was created to suit our intelligence, the plot attempts nothing but to relegate its fanciful planetary dénouements to the Hereafter and to the Beyond. The impossible pictures which have been drawn of heavenly felicity and of the torments of hell reveal the hereditary emotions of suffering creatures who are seeking an end to their earthly woes and looking forward to something which will be more satisfactory than is their present condition. In the last analysis, doctrine is, for most people, only the left-over change of emotional enjoyment. The invincible appeal

of a state other than the one accorded us is that which, more than anything else, throughout the ages has withstood the keenest criticism and the most firmly established scientific proofs. Such positive knowledge as we have acquired about man and the Cosmos does not satisfy those groping minds which at the start the dream of primitive ages lifted beyond impossible reality.

Are we to rely on dreams to fulfill our human destiny? Are we to be deluded by vague fictions which from the infinite depths of Heaven summon us to take our chance of an assured and eternal happiness? Who would not take the risk?

'How now,' the timid-minded protest; 'here am I, recognized by the Powers that Be as the owner of a ticket in the lottery of perpetual bliss, and you cold-bloodedly suggest that I exchange it for a pass that allows me temporarily to leave the bottomless gulf from which I emerged and to which I must return? Keep your dubious and debatable scientific demonstrations and let me have the expectation of future happiness, even though that hope be ill-founded. You talk of a cycle — of the serpent that bites its own tail. What of it? Suppose I am wrong, what can I lose? At least I shall have the satisfaction of looking forward to an apotheosis. Furthermore, if I am to be disappointed, I shall never know it.'

It is perfectly true that science does not seek to tempt us with a supernatural bliss, such as we owe to the hereditary obsession of a primitive dream which would have the world conform to our subjective needs. What science gains in hard-won facts, it loses through its inability to seduce the masses, which would rather be fascinated than enlightened. There is no room for the fictions of our errant imagination among the discoveries of positive science, which our imperative need of knowing will steadily extend. Ignorance can only be temporary, and knowledge enfranchises man just as surely as lack of knowledge enslaves him.

That man evolves is certain beyond the possibility of argument. The question is how, under what conditions, and

toward what end. Along those lines the opportunity for debate is unlimited. Verified observation will make openings in the jungle of the unknown. However, the problem is not merely to make such bright spots of truth appear. We must correlate connected interpretations with the correct emotional reactions which perfect them. Nothing can prevent the eventual dawning of the day when decisive coherence will require explanations very different from those adduced by metaphysics in which humanity so long lost itself. To-day we are only at the beginning of that mental revolution which will ultimately give emotional radiance to positive knowledge. Until that day comes, scientific discoveries will continue to shock the masses, still atavistically engrossed in the emotional perplexities of a mystery from which, if people but knew it, all vitality has long since departed.

The first of these preconceived ideas to which timid souls cling the most stubbornly because of the familiar emotional culture which has sprung from it is that the world is governed by higher psychic powers which are incompatible with the inflexible law of the evolution of relationships. Without the company of his familiar gods man feels himself lost. His gods may lead him astray, but they are traveling companions. At the very least, they may be spoken to. Shall we, then, have no one to whom we may complain? Do we not derive a certain relief from having asked for, waited for, hoped against hope for? Is there no satisfaction in having lived on promises, even if no deeds have followed them?

Truly, it takes a different breed of men to fulfill human destiny, such as scientific study of the Cosmos reveals it. It requires a different type of mind fully to assimilate the elementary reactions which cause phenomena. It takes stouter hearts to face the world without flinching. While we are waiting for evolution by repeated effort to produce this new humanity, every timid fear-ridden person runs to take refuge under the wing of his Divinity. Whoever would be a man in the best sense of the word will forge his own armor

before he takes his place in the battle-line. Will then our intelligence, which is the product of evolution, have fewer brave soldiers than the feeble intelligence of primitive ages? In by-gone times both Christian and heathen made admirable martyrs. What a retrogression from the early Christianity of Saint Paul to the miracles of Lourdes! And, in contrast, how the unselfish progress of knowledge has extended its dazzling achievements, which daily grow enormously in scope!

In the face of man's grim determination to know, the scaffold and the pile of fagots were powerless, and Galileo's grievous retraction dishonors not him, but his accusers. When we see the greatest scientists, and even Lamarck himself, begin by bowing the knee before the empty words of those very doctrines which they were about to annihilate, we can only conclude that the tide of general emotionalism had not yet swept them to that pitch of heroism which threw the early Christians into the amphitheater and made them triumphant.

If I were to go into the details of those tragedies of man and his god to which people of all ages have attached their hopes and their fears, it would be surprising how shoddy and paltry those legends really are — legends which, nevertheless, our ancestors never wearied of turning into poetry. After all, one could expect no positive development from a world which was puerile in conception, which thought that the Cosmos came into being as the result of an inexplicable whim, and that it would end by a caprice equally unaccountable. We are asked to believe that the world will some day sink back into the void from which it emerged, leaving behind as a memento of its brief existence an empyrean of bliss and a limbo of torment, which forevermore will confront each other under the disconcerted gaze of the Creator and of the 'creatures' who created him.

If we abandon these chimerical dreams of befuddled minds and accept the simple teachings of science, we discover that our past and our future are insolubly bound together by the laws which governed cosmic activities be-

fore we appeared upon earth, and which will continue to govern them after we have disappeared.

At the stage of thought to which mental evolution has brought us, we have no reason to expect to find either terrors or happiness in the functioning of the universal mechanism. What we know of the past sufficiently illuminates the future for us to recognize, even if we cannot fully understand, cycles the activities of which are beyond our limited powers of comprehension. That is much or little, according to the point of view. The infinite remains the infinite, of which our finite minds may grasp fragments, but never the whole. Many men, whose minds were inferior to ours, have lived, and doubtless many will live whose intellects will far surpass the current standard. New opinions will be produced, and hypotheses, which we now accept as such, will be confirmed or abandoned. Experimental tests will have been applied. Doubts will have been cleared up. We shall have discovered new means of attacking the problem, and we shall then be able to see many things which to-day are hidden from us. We shall see more clearly what we have already seen. It will not be long before new hypotheses become current; the test of these will be entrusted to the intellect of the future, and in that intellect we must have no less faith than we have in our own.

Even now, may we not say that such positive knowledge as we have acquired throws considerable light on certain aspects of the future? No one will maintain that it is a matter of indifference to us whether we arrive at the unknown term of our evolution as the result of the exhaustion of an unbalanced mind, or by progressive and ascending stages which constantly bring us nearer an understanding of the infinite. If we are to follow the latter course, it is obvious that we must be allowed to base our ideas on scientifically established facts and to argue from them. Can there be any question of this?

We can conceive of only two possible ends for planetary evolution. The first is a collision with some other astral body, which like our own planet is at this moment rushing

through space, quite unaware of the impending crash. The second is the indefinite cooling of our world until the day comes for some new birth of the unknown. If one single mortal might survive to behold it, the catastrophic end of civilized life in the prime of its vigor would seem to him like a Sardanapalian cosmic pyre supplying a climax to a monstrous Balthasar's feast. Is it possible to dream of a *finale* more ultra-romantic than to suggest that in the full triumph of a knowledge evolved only after solar revolutions without number whereby we had at last attained a superior stage of relativity, we should be buried beneath the ruins of our world?

Of course, on that day man would have become supremely just and unselfish to a degree beyond the power of words to describe. There would be no tribunals of justice, for there would be no offenders. There would not even be any officials. The man who killed a butterfly, even though to feed himself, would fall under the ban of public opinion. Orators would conduct schools of silence. All would refuse to accept the task of governing, on the ground that it was an unnecessary function — even a dangerous one to society, as some would argue. The very meaning of the word violence would have been forgotten. Life would consist of pleasantly mild emotions. Purely as curiosities, and as relics of the dim ages of atavistic barbarism, a few pictures of the battles fought in ancient times would have been preserved. Man would have discovered that the highest teaching was to do good, and not merely to talk of it. We should have passed the peak of the curve and have begun to follow the down-slope, retrogressing from the organic to the inorganic, and thence into nebulae rarified to the verge of nothingness.

But we must take all contingencies into account; it is quite possible that the end may come upon us in our present state of imperfection. This would have the very real advantage of sparing us the useless labor of singing our own praises too loudly and of simultaneously doing too much evil to make it possible for us to reconcile the contradictory results. Swift suggested that, as an alleviation of the Irish

famine, all the small children should be eaten. The empiricism of England prevented the adoption of the plan. That was perhaps a blunder, for, as the children could not eat their parents, they died just the same. It is quite possible that, were this planet to revert to the solar furnace of which it is only a cast-off spark, the event might surprise us so suddenly in our grossly imperfect condition that we should not have time even for regrets.

What are we to say of our partial evolution? With considerable difficulty we can go back some five or six thousand years to the dawn of history. We find that, to-day, we are not much more concerned with the sorrows of other people than were our ancestors at the time when Fa-Hien and Hiouen-Thsang traveled from China into India in quest of a philosophy of the world and of man in keeping with their lofty ideals. If the man of Chapelle-aux-Saints has been able to wait in his grave some fifty thousand years for our advent, why should we be more troubled over the total loss of our records the interruption of which we anticipate than we are over the loss of the records of the past?

The grossly improvident manner in which we increase our consumption of fuel when we know that the supply is limited suggests that our interest in the future is more academic than real. Since the end must come, it is senseless to worry lest we die of a Wednesday without knowing what will befall on Thursday. Hence, regardless of how we look at the matter, we can find no reasonable ground of complaint that we are subject to a fate similar to that of all other forms of life, whose 'rights,' in terms of the Cosmos and of the 'Creator,' are identical with our own. If, through a telescope we could identify the particular star, incandescent or extinct, the preordained lot of which it is some day to collide with our earth, we could logically bear it no more ill will than we bear to the fatal germ which may kill us before the anticipated end of the world.

We must not, however, overlook the fact that an astral collision is not the only menace which hangs over our heads. Our life depends on the sun, and the temperature of the

sun is falling at a regular, mathematically established rate. Since all the achievements and all the failures of humanity are directly traceable to the temperature of the sun, the problem is a serious one. A change of a few degrees only would revolutionize us and our world. I am in no way complaining of present conditions; our sun, the heat of which is variously distributed, is quite adequate for our needs. On the other hand, I call attention to the fact that such was also the situation in the days of the man of Chappelle-aux-Saints, and in those of his ancestors. *Their* sun saw them born, and even watched them flourish temporarily. We have no means of following the evolutionary changes which divided the old from the new sun — which is one and the same. At least for a time our descendants will surely adapt themselves to the sun of the future, since if they do not, they will die.

The wails of ideology cannot change the fact that evolutionary activity becomes exhausted in the case of certain peoples, even to the point of causing a retrograde movement. Of this the decadence of Asia, of Greece, and of Rome are concrete examples. In each of these cases, a purely organic weakening had a serious effect on the course of civilization. The evolution of the human race has always been conditioned on a succession of general evolutionary movements, the rhythm of which alternately became faster and slower. There are periods of pride and of misery, waves of excitement and of depression in the course of cosmic action in which alternately successful and unsuccessful efforts of uncertain duration reach adjustment. The help of every weakness of character that under high-flown names determines the principal currents of that debile emotion by which the greatest races of history have been overcome is assured in advance to the most distinctive forms of regression. Moreover, the tillable land in the world is necessarily limited. If the evolution of the human race continues, it might easily happen that surplus population would so disturb the natural equilibrium that famines or wholesale massacres would be required to thin the ranks of

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a superabundant civilization. The inevitable operation of the Malthusian law cannot be left out of our calculations.

When amid a bombardment of flaming projectiles, the solar volcano hurled into space the huge chaotic mass which was to become our world, the gradual cooling of that great furnace began to fashion an amorphous ingot of planetary elements which in time was to contain all the different forms which we call life. As the temperature dropped, our oceans, then vaporized by the solar heat, condensed and fell in torrential rains. The waters filled the craters made by the explosions of fused matter in those sedimentary deposits in which in future times there were to be discovered organic forms that had been generated in the waters warmed by the sun of a forgotten age.

I draw these fantastic pictures, for it is necessary to go back to those remote times if we are to follow the series of the transformations brought about by falling temperature. When one compares the luxuriant growth of the forests of the carboniferous age with the organic life of present-day temperate climates, the fact of transformations seems amply and conclusively proved.¹ As the lowering of the temperature proceeds, it will have as great an effect on our future as it has had on our past. New environments will produce new types. The fact justifies man's terror when he sees the progress of a retrograde evolution which threatens to destroy his powers of resistance. He becomes the frightened spectator of an ebbing of vigor which bit by bit carries away all the orderly adjustments of his life. Man can measure his failures by the achievements to which he aspires. In the past, he had to hope, since he was always in need of something; to-day, the whole magnificent gift is withdrawn. No 'noble despair' can help him. He is hungry; he is cold; his resources are exhausted. The whole world and he himself seem to have changed. The best that he

¹ It has been argued that the 'luxuriant growth' was not due to the prevalence of a higher solar temperature. It is quite true, as Arrhenius points out, that a change in the composition of the atmosphere might account for the differences between the torrid and the glacial zones. In both cases a lowering of the temperature occurred.

can ask of fate is that his reactions of sensibility, benumbed by organic retrogressions, may induce an apathy so dull that he will be wholly indifferent to the last throbs of his destiny. The Unknown, in the form of a new monster, rises before him and assails him with constantly increasing vigor to which he can oppose only a waning energy. At last he knows the fate which his race has deliberately imposed upon so many others and comes in his turn to grips with the law of the strongest. In the universal struggle for existence, he will have been permitted emotionally to travel through the complete circle.

SHALL WE RELY ON FACTS OR ON FANCIES?

I deliberately avoid the classic question how the world will end, as the Christians of the year one thousand understood it. India had put Brahma under the dominion of Brahman in a measureless cycle in which æon followed upon æon. As India conceived the matter, the world was made up of successive emanations, not a creation *ex nihilo*. The Jews, indifferent to the question of an immortal soul, contented themselves with earthly good or evil. Held under the spell of Holy Scriptures written at a period when 'prophets' thrived in unrestricted freedom, and realizing that for the time being the sacrifice on Golgotha had not fundamentally changed human life, the Christians proclaimed an 'end of the world,' after which at last Jesus would triumph. Long before the Apocalypse of St. John, other writings of a similar tenor had appeared under the guise of 'prophecies.' When the day of fulfillment is indefinitely remote it is easy to prophesy! It is hard to observe accurately under the criticism of experience and in that freedom of criticism scoffed at by the Church.

The year one thousand marked the final disappointment of those who prophesy. At least since that time the human race has apparently become resigned to living in a state of provisional and relative knowledge, to be replaced in a future life — the 'only real life,' — with the absolute knowledge of which immobility can be the only manifestation. On the

subject of 'the end of the world,' the Church has been obliged to take refuge in silence. And, since the extinguishing of the fires of the stake, we have been allowed inductively to reach conclusions on the march of phenomena and on the guiding lines of experimental progress.

I refer to positive knowledge, not to a mere prolongation of that atavistic emotionalism which delays and disfigures true knowledge. At this point the successive, organically connected states of sensibility reveal in us conflicts between the 'I' of present knowledge, and the 'I' of atavistic misconceptions, now become 'He,' through the reverberation of incongruous emotions. Inevitably, these twin characters, representing two aspects of the same personality, will argue as follows:

He: Do you mean that all you can offer man is annihilation, not glorification?

I: If I had my choice, I might be weak enough to favor the glorification, even though the trials of life are more apt to build up a fine character, whereas generally too much happiness tends to weaken us. The whole question is to know whether or not I have any choice in the matter.

He: In that case, I'll take the liberty of claiming that *I* have the choice. It is a risk which I am willing to take. You have mentioned a lottery of life. Even if the lottery is never drawn, I shall have had my hopes, and Pascal will tell you that hopes are worth something. What alternative do you suggest? To struggle on, only to be swallowed up in the Great Void? Excuse me, but that does not suit my temperament.

I: I suggest nothing, for I can discover nothing in man which permits him to escape his destiny. Is it a matter of explaining the world by a doctrine fitted to our aspirations, our visions, and our whims or of seeking to find the law of the universe in the relationships of the elements for the sake of adapting ourselves to it?

He: That's all very well, but I cannot adapt myself to it.

I: Would it not be more accurate to say that you do not wish to adapt yourself to it? The fact that I and many of

my fellow beings — men by no means negligible — have been able to adapt ourselves to it is an absolute refutation of your argument, since it proves that such an adaptation is quite possible. You are constantly adapting yourself to the inescapable requirements of your various organs, just as I am. Why, then, do you abandon in this case an experimentally proved biological generalization? Ever since you were born there has not been a moment when you have not been subject to your organic constitution. You may assent, or you may dissent, but whatever your answer, the cosmic laws which govern you will continue to follow their course. In general and in detail you will carry out their decrees, and you can no more escape from the working of the synthesis than you can from any one law, such, for example, as the law of gravitation. We may as well recognize the fact instead of vainly disputing it.

He: How can I recognize something which I cannot feel? If your proof drawn from experience is sound, why is not my proof drawn from sentiment just as sound?

I: Because your sentiment cannot be so verified as to convince any one else, whereas my knowledge is wholly corroborated, for it has run the gauntlet of different investigatory procedures, all of which led to the same result. That is what we regard as the touch-stone of truth. Can you deny that we are making great progress? Don't you find yourself almost daily obliged to give ground, as, in fact, you have had to do ever since Galileo was condemned? Only experience can give uniformity of knowledge to man. Your 'sentiment' divides men rather than unites them, because it is based on personal emotions, for which there is no common standard. 'Sentiment' may exalt man to a peak far above himself, but, without the support of continuous experience, his fall is inevitable. Knowledge alone can trace the connection of organic activities, and knowledge alone can establish and harmoniously consolidate the interests of all.

He: What interests?

I: Living for the improvement of each and of all, within the limits of planetary life from which I cannot escape. So

living as to do my neighbor no more harm than is inevitable. Of continually growing in knowledge, which will bring me a higher self-respect by providing me with increased means of helping my neighbor.

He: What do you care about all that?

I: Come! Do you mean to tell me that you derive no satisfaction from doing good for the mere pleasure thereof? I could not, without offense, impute such a thought to you. Are you disconcerted because I can offer you no other reward? Personally, I take pride in the fact that I ask for none from you. Is man to continue forever to be tossed about between the hope of reward and the fear of punishment as, in the days of his immature mentality, he conceived was to be his lot? Will he never be willing to recognize the value of disinterested acts and motives? As I visualize him in the cosmic order, he will continually progress from stage to stage. Perhaps unintentionally you belittle him. Again, can you not see that the vulgar reward which you ingenuously grant yourself is valueless except through the ingenuous hypothesis that in their ignorance the first thinking men so eagerly took up? They gave you their Gods, and all you have been able to do is refine and 'civilize' them. Of what avail is a form of happiness which you cannot describe? Does not your very inability to define it pass judgment on it? Your hell consists of a continuation of earthly woes, and of nothing else. Your heaven is a collapse, an annihilation of all energy, a complete immobility which is in the greatest contradiction with the order of the universe. Furthermore, your hell is far more terrifying than your heaven is alluring. And, if one is to believe the Church, the damned far outnumber the saved.

He: It is not my fault if I am unable to define in positive terms what I feel most strongly. You, too, sometimes have the same sensation.

I: As a matter of fact it is not necessarily your fault. But your shortcomings are none the less patently proved when in flat contradiction to science you try to build a world out of the mistaken dreams of primitive man.

He: On the other hand can't you realize that if you are going to make life bearable for me, you should not begin by cheerfully killing all my comfortable hopes?

I: That was indeed worth consideration when man was just beginning to acquire knowledge. To-day, the problem is to find out whether you can justify your hopes; whether you want to live on dreams or on facts, to surrender yourself to the stupefying drug in order to enjoy an unreal life, or, with head held high, serenely to make the effort to attain the superiority that a full life gives. Must I go into even greater detail? As to that 'Hereafter,' of which you are so afraid, that ineffable sweet sleep that no nightmare disturbs, to protect you from which you call in an army of phantoms, I tell you flatly that you can attain to that happiness only after pitiless suffering. I cannot, against your will, make you broader and finer, nor can I make you feel the urge toward a higher standard of unselfishness. I am trying to bring you face to face with the direct opposite of the apotheosis which you visualize, an opposite which I do not hesitate to offer you as the supreme end of your destiny. To you who need the bait of a reward to interest you in the higher achievements of knowledge, I say frankly, not only that I have no reward to offer, in the sense in which you understand the word, but that the more unselfish and high-minded your efforts are, the more likely it is that you will be hated, scorned, slandered, and subjected to the most bitter attacks. You have only to look back through the pages of history to see what reception has been given to the men who nobly strove to bring enlightenment to mankind. If you can bring yourself to be sufficiently broad-minded, study the supreme serenity of Socrates' farewell to his judges, or the touching lament of Christ.

Has not that emotional state which brought about so many crimes come to the end of its evil doing? The religion of torture, which the Spaniards so cruelly practiced in their conquests of America, finally came to an end — at least in its most frightful aspects. And yet, certain fundamentals thereof have survived in the modern hypocrisy of our social

ostracism of people on the ground that they are heretics. Unselfishness, based on the selfish fear of punishment, even when disguised as altruism, is the mark of a lack of intelligence and of heart. Human activities are composed of successive rhythms of egoism and altruism, and great credit is due the man who does not count the efforts he makes in a labor of humanity that is above reward. He is fortunate if he is not punished for his pains.

He: In this theory of yours, what importance do you attach to public opinion?

I: None, until I know on what it is based. The masses are just as often wrong as are individuals, and even more often. One reason is that an error is frequently established as a truth because so many ignorant people impulsively confirm it, whereas the individual who can form his own opinion can govern his conduct with no help but his own. Consequently, and under all circumstances, I maintain my right to disagree with my neighbor. We cater to public opinion because we hope so to advance our own ideas. Should we not then wish it to have some worth? Most certainly we should, since, whether ignorant or cultivated, a mixture of truth and error is implicit in it. Nor should it be forgotten that opinions founded on emotion are so unstable that we sometimes discard them as quickly as we accept them. It may be disastrous to attribute permanence to the passing whirlwind. You know as well as I that even the ablest minds often find it difficult to form an opinion, and that the most cautiously formed public opinion is by no means sure to be correct. Of this you will find no better examples than the debates on the question whether the earth rotates, and whether the sun revolves.

He: Do you suggest that I judge the conception of Divinity by the same standards?

I: If you give due consideration to science, it will be difficult for you to do otherwise. When I form an opinion of your ideas do I not test them by my own experience? If you will tear away all the superstructure of verbiage and consider the matter dispassionately, it is quite possible that you

may find that our disagreement is due to a difference in our emotions. You live in fear, whereas I have faith in courage; that is the true reason why we cannot agree. Alone, at grips with the impassive universe, man, called upon to rely on nothing except himself, finds that he can (or that he cannot) oppose the ardor of his sensibility to the unconscious elements. Standing firm against the assaults of the Cosmos, he is responsible only to his fellow-beings. The argument deals no longer with incoherent, atavistic fairy tales, but with the actual cycle of experience with the accepted facts of the indifferent universe. It is the dramatic struggle for supremacy between organic activities and cosmic powers.

He: And afterwards? What? Slight as the illusion of hope may be, it still lets me hope, even if your hypothesis turns out to be correct.

I: That is the opium-eater's theory when he lulls himself with the dangerous dreams his drug brings him. It is similar to the confession of the Oriental who will not face the strife of life, but prefers to build for himself another world out of the artificial stuff of his slothful bliss. Shall we live on the tangible realities of science, or shall we have recourse to artifices of a fiction which disguises life? 'To be or not to be.' Let us each choose a task within the limits of his courage.

LIFE AND PROGRESS

Positive knowledge is the touch-stone of thought. The lives of animals depend on the sum of primitive observations which they have been able to accumulate and coördinate. We live in proportion as we have understood. From a cosmic point of view, life is wholly insignificant. Humanly speaking, it is the finest of our achievements, and we have the choice whether to let it slip between our nerveless fingers, or with all our might to make the most of it.

It would not be proper to judge the problem of knowledge from the point of view of two kinds of mental development. One group lies supine in a religious sanatorium; the other

group is eager to drain the cup of knowledge and tries to reconcile its human emotions with scientifically proved facts. The former seeks to hide; the latter marches bravely to battle. Is that not what is bound to happen in all the conflicts in which humanity is involved? Since man's ability to learn evolves, those who are wavering will ultimately bring assistance to the strong men of to-morrow, who are not necessarily the strong men of to-day. It cannot be adduced as an argument against our explanations of the universe that we require education and time to recognize them and to adapt ourselves to them. We have not the right to ignore relationships which exist, and which our sensibilities can test. Nor have we the right to decree ephemeral and human solutions to the vast tragedy of the world, the plot of which is eternal change. We must not expect to escape from the organic laws of which we are a transient product, merely because to do so would suit our transient emotions.

The successive 'Providences' have completely failed in that rôle of torch-bearer which was assigned to them. They no longer satisfy the growing needs of evolved minds. Those minds are now so numerous, and their power to understand is so great, that they constantly demand increasingly strong positive guarantees. And yet our accumulated knowledge cannot fulfill the function of orienting our consciousness unless it goes hand in hand with an increasing adaptability in our emotional nature. That is because emotions and not syllogisms are the mainsprings of action. Has any one except ingenuous school boys actually accepted an argument built up according to rule? Is it not rather a succession of emotional impulses, sound or unsound, which are responsible for what we do in this world — impulses which, *afterwards*, logic may justify? Independently of feeling, academic logic was never more than a virtuoso's arpeggios pretending to be a symphony.

How shall we attack the problem of the hereafter better than by studying the present? No other method is possible. Life and death, conditioning each other, are infrangibly

bound together. An ordinarily intelligent person can ascertain just where we fit in the world-order by merely making a series of methodically coördinated observations. In the past it seemed simpler to proclaim an 'immortal soul,' that is, the unknown, as a means of explaining evolving man, before we had taken the trouble to learn about him. And, as the unknown 'soul' can in no wise be an explanation, we end where we should have begun, that is, in attempting to observe the organic phenomenon in order to define its functions. Then came the characteristic attempt of the human intelligence, which consisted in putting man into his proper place in the Cosmos so that he might live through experience conscious of facts as they are. For a long time to come the man who can explain everything without knowing anything will enjoy an unfair advantage over his unfortunate fellow-being whose fragmentary knowledge prevents his reaching absolute conclusions.

Was the universe created for the benefit of man, or is man a transient incident of the universe? We cannot leave the question to be answered by our emotions, that is, according to our personal inclinations. We must interrogate the elements themselves, and we have discovered that if we do so in a methodical manner, they will not remain silent. To set up against them our purely individual preferences is an act of ingenuous presumption. Destiny, whether fair or foul, must be fulfilled. Predicting an outcome does not insure its reality. Inevitably, the hour will strike when man, who is but a phenomenon of time and space, must, because of the inter-relationship of his successive energies, recognize the connection between the evolutionary stages of his development and those of the cosmic ocean from which he emerges only to be immediately submerged again.

To be is to grow. The remark is as true of stones as of plants, of animals as of thinking men. That which will be eternally follows that which has been. Life gives us consciousness through the contrast of pain and pleasure. They are the poles of our sensibility. And in the sensation of that pain and of that pleasure lies all our knowledge of the universe and

of ourselves; it is the strong link which does not permit us without a pang to finish with that torturing unknown into which our birth precipitated us.

Having attained definition, we shudder at the idea of a fatal return to the indefinite state from which the march of evolution has progressively freed us. Yet man, freed from the fetters of his 'gods,' cannot and should not depend on anything except himself for the fulfillment of his destiny. Unfortunately the difficulty of setting himself free from the atavisms of which he is the product often prevents him from making the most and the best of himself. The outstanding feature of his equipment for life is that the chances are all against him. Add to that his doubts and the hatred and the bitter attacks which his aspiration to be independent will draw upon him from persons of weak character. To emerge victorious from the battle he will need all the resources which his mind and his courage can supply, and above all he will need the quality of stubborn patience.

And in addition our attempt to determine by our own efforts the elements of the universe will require the aid of that 'fruitful illusion' so welcome to those batterers of walls who ceaselessly besiege the Cosmos with their questions. Alas, the fortress is impregnable, and all we may hope for is to make a breach in the bastions. Great our hopes, modest our expectations! We must gird ourselves with the contradictory weapons of moderation and ambition.

No matter how far primitive emotion may have carried us, how can we refuse to set aside a time in which to ponder the fundamental problems of 'progress'? I observe the phenomena of evolution, and, for a certain distance, I can retrace their path, as one follows a stream upward; but as it flows down toward the indeterminate reaches of the unknown, I can only guess at its course. The more daring the guess at the unknown, the more enthusiastically will the masses seize upon it as their own.

What will be the issue of human evolution? In all the attempted answers, imagination with its fairy-tales has so far had too great an advantage over the insipid 'What do I

know' of a too quickly exhausted knowledge. What 'progress' will make of living humanity may be speculated upon indefinitely. The facile idealism of the street-corner is prolific of happy phrases calculated to suggest every variety of those movements based on puerile hope in which a tumultuous ideology is canalized.

Meanwhile the question what will be the end of our existence remains unanswered. The destiny of our planet and that of the human race are inseparable. They were bound together in the past; they are bound together in the present; they will be bound together in the hereafter. The masses are indifferent to the past; and, forever preoccupied as we are with vague hopes, or rooted in childish expectancy of seeing some hallucination come true, we are less concerned over the present than we appear to be. We have seen the greatest minds (such as Newton), like strong trees bending before the storm, unable to help that atavistic surrender of knowledge which keeps us bound down before visions of a Paradise in which dwells a superhuman humanity.

At the stage of intellectual development which we have reached, every 'believer,' in considering the 'Hereafter,' draws for his intimate self a picture of paradise to suit his own fancy and leaves to Providence the task of reconciling its infinite mercy with eternal damnation. Scientists and philosophers, who are more exacting with themselves, sometimes seek outside the limits of their science ingenious hypotheses, which offer greater latitude to imaginative wanderings. We have not forgotten all the talk of a 'Superman' which emanated from Germany.¹ Its purpose was to give a name — if nothing more — to the uncertain miracle of an unknown form of evolution. This teratological product of metaphilosophy is as sound, and no sounder, than a soap-bubble. In course of time, evolution will make of each of us a 'superman,' in terms of his ancestors, and a 'sub-man,'

¹ The 'Superman' is merely an unknown quantity in dress uniform. We should accomplish about the same result if we called the pithecanthrope a 'sub-man.' How can one foretell the effects of evolution, which depend on changes in the organism as well as in environment, both of which undergo constant modification?

in terms of his descendants. Nevertheless, lest we take away the inalienable right of great minds to use their imaginations, we must concede full liberty to all prognostications as to the progress of that evolution which is the law of the universe. The scientist himself would not be a scientist if we denied him the right to dream.

What can we set up against the lyric vision of a paradise based on earthly realities, unless it be systematic science? We must not ignore the fact that, like the chimeras of the past, an illusion based on hypothesis may be a temporary life-belt thrown to minds tossed in the cross-currents of conflicting possibilities in the ocean of the unknown.

The man of yesterday, lost in his forest of question-marks in which appear a few open glades, and the man of to-day, equipped to reach scientific conclusions, are through the clash of their sensibilities preparing phases of evolution among which the man of to-morrow, in whom ancestral emotion will still find an echo, must choose his path. Through their unbreakable relationship all those sensibilities govern the eternal activity of that 'afterwards' which is the eternal result of every phenomenon. Hence, the universe becomes a perpetual sequence of 'Hereafters,' each of which determines its successor, and which all together transmit tendencies which can never die out. Consequently, the meaning of 'Hereafter' is really identical with that of 'Heretofore,' which in the course of phenomenology had in its turn become 'Hereafter' merely by a difference of time.

We trouble ourselves little about the various prenatal events which make us what we are, but our indifference becomes agitation and even terror when we consider the series of events which are to follow our death. The emotional turmoil can change nothing. If we could only grasp that fact, we should be spared the folly of setting up imaginative theories in which we triumphantly interpose as the governing element whatever at the moment best suits our convenience.

Issue of cosmic law and consequently subject to the

inflexible determinism of things, we present to the universe of which we are a conscious part sensitive surfaces over which play fleeting pictures that set the opinions and resolves of an Ego against the infinite Cosmos from which we derive for our use our whole provision of energy. Just where, pray, in the marvelous sequence, can we properly break in with that ridiculous wail of ours of 'What of the Hereafter' which merely proclaims our addle-patedness? It contains the imaginative implication that there is a fixed point in a universe which is constantly changing. It falsifies the true value of phenomena for the sake of formulæ which have no equivalent in cosmic fact. Once again, it is attributing objectivity to mere words.

After having received everything from a coherent Cosmos, how can we impose on that universe any part of our incoherence? If every moment of that universe is a part of a flood of 'Hereafters,' perpetually transformed and perpetually equivalent, and if the 'Hereafter' of the ascidian, or of the amphioxus, is nothing less than Newton, why should the journey from Newton to X be more marvelous than that from the ascidian to Newton? When the problem is posed by the nature of things, why should we wish to solve it without reference to the elementary conditions of the Cosmos?

Our contemporaries might be expected to feel some perplexity when confronted with such a problem. Far from it. Instead, they load themselves down with all manner of contradictory theories and try to go through life without giving up their pet beliefs and superstitions, the only advantage of which is that they seem to offer a hypothetical chance of eternal bliss or of eternal damnation. Apparently, this chance seems to them preferable to the complete fading away of their personalities. To put it in another way, they mentally stop the hands of the clock of progress in an attempt to keep the phenomenon from vanishing.

When boiled down, all this incoherent talking amounts only to the fact that our present answer to the question of what is to come hereafter can, according to the inductions

of experience, consist only of the component elements of a past made up in part of pleasure and in part of sorrow, the permanent gamut of all the sensations of life. Where are we to seek 'progress' if not in the facts of the present, studied with reference to the past? It seems the most natural thing in the world to discount the future for the benefit of hopes pushed to the point of hallucination. The kinetics of our primitive mentality makes that inevitable. But we should beware of being more positive about what is to occur than we have been about what has occurred. If we substitute a chimera for mental effort, we shall be pronouncing judgment on our own destiny.

If there were an underlying design in the universe, our desire to find it out in advance would be more easily gratified. For reasons which I have stated, the fundamental question of 'design' is that on which we differ most radically. People, who are convinced that they have discovered the secrets of their Providence, take great pleasure in expounding subjects of which they are profoundly ignorant, and with much gravity point to the fires of hell as the surest foundation of their particular happiness.

On the other hand, we, simple human products of universal evolution, are struggling with phenomena, knowing well that their unending phases must outlast us, but determined at all cost to bring to light — so far as we can — something of the unknown, which eludes us at every turn of every activity. Meanwhile, votaries of absolutism, who, like Villon's wolves, are fated to live on air, cheerfully go their ways and accuse us of being materialists, though in truth the 'soul' of the metaphysicians themselves has so far been unable to show itself without the aid of that medium.

The chief advantage of the theory of 'design' is that, since Divinity is silent, we can in its name create a plan of the universe to suit our tastes, whereas, if we recognize the dominance of the elements, we can do nothing but accept our destiny. In view of the established laws, it is quite impossible to assume that the evolution of humanity will go

on forever. The idea that we may remain stationary, or even retrogress, is especially distasteful to us. The point is, after all, quite immaterial, since we have not been, and shall not be, consulted. Is it not conceivable that our evolution will come to an end before any planetary transformation occurs? What will happen to us when we no longer have solar heat? The matter does not even enter our thoughts. When their environment changed radically, the dinosaur, the archeoperyx and many other animals that had given no thought to the future came to an end. Had they like man been able to philosophize, it would presumably have been a matter of regret to them.

The complexity, the beauty, the lack of harmony of our evolutions in no wise affect our inexorable fate. It almost seems as though there were a sort of justice in making us pay through self-abnegation for a life which may be made æsthetically complete. Like the words that we cast at random into the inattentive universe, the activities of our emotional nature, absorbed into the infinite cycles of the universe, can but be translated into oscillations of energy which, according to rhythms that provoke all our romances of the universe, scatter or concentrate without so much as affecting the trajectory of a single electron.

To prove my contention, I shall call attention to the numberless generations of all organic types, the fate of which allows us clearly to foresee our own. No matter at what stage in the scale of animal life I pause, I always find the same permanent evolution of organic activities. And I find the same successive phases leading up to the same ephemeral products. 'Beginning' and 'end' are but schematic points in the insensible transitions between one evolutionary movement in a connected series and the next. Our pithecanthropic ancestor bequeathed to us the authenticated credentials of the Javanese bones of the pliocene age, when he philosophically slipped out of life without a murmur of protest. The same is true of the man of Chapelle-aux-Saints, who was the first of our present-day savages, now dying out just as the ancestors of that same anthropoid

became extinct. Is it not inevitable that the stages of our diverse humanity must follow a similar course? One by one the races with whom history began have become worn out and disappeared.

'But where, pray, is that King of Spain
Whose very name I do forget?
Lo, where is mighty Charlemagne?'¹

Everything ends and everything goes on in a common movement. If we looked long enough, we should eventually discover order in our own disorder.

Are the disorders of our civilizations as excusable as those of our savages? I hardly dare express an opinion. A savage does not burden himself with much thinking. His life is one of sudden action, and it gives him as much satisfaction to sink his teeth into the flesh of the innocent as into that of the guilty. He so candidly manifests his animal strength, that civilization is rightly proud of having mitigated it. We talk much of justice, of liberty and of a thousand virtues peculiar to human subjectivity, which we do not propose to practice until some period in the 'Hereafter' — a fact, which so far has produced 'peaces' of variously regulated violence.

Whether war is an interlude in the comedy of peace, or peace an interlude in the tragedy of war, the fact remains that we continue willing to bear its bloody trials and that we even seek it and boast of it. Why, then, do we so lament over what seems to us the unspeakable tragedy of an end which consists of unbroken rest? I cannot but believe that we shall come to accept death as we do life — as we find it. The few centuries which it may take to accustom us to the idea will unquestionably be forthcoming. History proves that man is as readily believed when he shouts 'I can,' as when he cries 'I cannot.' Remember how cheerfully the heroes of Greece went to their death, although they did not believe in a future life. Is not the point clearly proved by

¹ 'Hélas! Et le bon roi d'Espagne
Duquel je ne sais pas le nom?
Mais où est le preux Charlemagne?'

François Villon, *Ballade des Seigneurs du Temps Jadis*.

the hundreds of millions of Buddhists who for the last three thousand years have striven to make themselves worthy of complete annihilation, which they deem the supreme reward — even though it is scorned by Christians who are no better and no worse than they?

DEATH

Whither do we go? The answer, which so alarms our refined and sickly susceptibilities, can be obtained only by scientific deduction. All the forms of life in the successive states in which consciousness lights a flame that will gleam awhile and then die out, must undergo the same fate.

I am obliged to admit that this purely objective answer does not satisfy the subjective impulses inspired by the wonder which we feel when we contemplate ourselves. If mere words will satisfy you, the Church will supply them to your heart's content. But if you are capable of the mental effort requisite to the task of seeking a comprehensive view of cosmic movements (of which you are one), you must show yourself worthy of fulfilling your destiny.

I have spoken of scientific induction. This planet, and its companion, the sun, are continuously changing as the result of cooling. Stars break into flame and are divided; others collide and gain renewed life. Regardless of the point in mental evolution which we may have attained, at some time in the indeterminate regions of space into which we are blindly rushing our planetary system is bound slowly to fail us, and the grandest achievements of humanity will be wiped out. And since these 'transformations' are constantly occurring in infinite space and time, there is no escape from them. To prolong beyond the span of life joy or sorrow, which are the ultimates of organic sensibility, is to show a childish ingenuousness. The common constituents of the motive reactions of life are cosmically interconnected, and that relation makes of them the two poles which are the necessary part of a single biological activity. If man is to carry on after death the conditions of his life, Paradise will have to contain elements of suffering, and Hell elements of joy.

No sensations and no emotions are in greater need of regulation than those which terrify the common run of men at the thought of death. If we are to steer our own lives through the reefs, and if we are to pass judgment on ourselves with due human dignity, we must study the problem with the greatest care. Everything that lives is condemned to death at birth. That law has no exceptions, and is subject to no modifications.

The insignificance of man's life may easily bring on a form of philosophic despair that leads to suicide — which is merely anticipating the extinction of that insignificance. The epigram of Leonidas of Tarentum is a familiar quotation from the Greek Anthology: 'Infinite, oh man, was the time before thou camest upon the shores of Aurora. Infinite, likewise, shall be the time after thou hast descended into Erebus. What, then, is thy portion of life? Perchance it is a point that hath no size; perchance even less.' Irrespective of what his previous history may have been the 'Phidon' to whom the epigram was addressed may well have put an end to his days because life seemed to him too short. He may be likened to a theatergoer who leaves the theater because he has been told that the play will end. It is easier to understand Saint-Évremond when he says: 'If one considers the sorrows of life, it would seem that the greatest blessing would be to end it.' Phidon and the epicurean Saint-Evremond to the contrary, all men, of all creeds, have one sentiment in common — the love of life.

Words afford us an escape from cosmic fact. On the other hand, the 'entity' which, it was alleged, made possible an after-life has not even been able to supply any sign of its existence. In no circumstances would any one bring against an experiment in physics or in chemistry the argument that it was personally distasteful to him. And yet, the phenomenon of the transition from the physico-chemical to the biological order (which constitutes birth), or from the biological to the physico-chemical order (which is death) is in general bitterly contested on the sole ground that it offends the personal emotion of the subject. It amounts to

maintaining that man determines the world; and the contention is becoming hard to support.

How, then, are we to account for this cowardly clinging to impotent life? Life, whether profitably used or wasted, whether made up of brief joy or continuous sorrow, we wish to preserve as a supreme treasure and to live forever on the sole ground that on a certain day we were alive. This senseless love of life is the great and common passion in which unite the discordant and harmonious elements which form our sensibility. Logically or illogically, we insist on living, and we maintain that we are eternal, even though that eternity is obviously contradictory, since it has a beginning. The real reasons that men lay such store by those wisps of smoke which they call glory is that they find in them something which smacks of survival after death.

Can we not do better than plead the extenuating circumstance of the impact of the cosmic force which may happen to interrupt our passage through life? We can easily understand that the interruption is regarded as cruel when flattering hopes continually haunt us with their deceptive visions — fragile bonds that break indeed, but only to catch again and unite more strongly than ever. Are we forever going to allow the inexpressible charm of these fancies which so effectively temper the sorrow of the moment to make us forget the huge rhythm between the torture of life and the peace of death? Shall we so far forget as to transpose, and even to reverse in our heart of hearts, the natural impulses of our sensibility?

It would be paradoxical for me to maintain that life is a temporary woe, and death the supreme state of happiness. I do not in the least believe it. I fully appreciate the great achievements of consciousness, with their attendant and inevitable sequence of joy and of sorrow, which, at least temporarily, we have the great privilege of enjoying. Does that imply that the privilege is perpetual? Does it mean that, because our life is too short, we are entitled to deceive ourselves into considering as the supreme misfortune the coming to an end of that mixture of happiness and of woe which we never cease deploring?

The actual fact is that generation, birth, and death are a single phenomenon, interrupted by the beneficial interludes of sleep — a temporary taste of death which we welcome eagerly. To attempt to divert or modify the phenomenon to suit our preferences is quite as absurd as it would be to seek to stop the course of a star to gratify a momentary whim. And yet, curiously, that is just what we seriously try to do.

For a whole tick of the clock, the world is given us, thanks to the organically connected reactions of our sensibility. We cannot escape the swings of the cosmic pendulum, but by great good fortune our determinism, which is responsible for our consciousness, can take us back into the realm of insensibility. If suicide is an escape for the man who has suffered to the limit of his powers of endurance, is it not also true that advancing old age slows the course of all our organic activities until we come to the verge of that physico-chemical transformation which marks the exhaustion of the organs? Hence the problem of life and of death does not so much concern cosmic reality (of which even the martyr's fagots could not demonstrate the divine nature), as subjective states of mind which, like a magnifying glass, distort the Cosmos when we pretend to observe it.

However, just as the evolution of our knowledge has changed our point of view from that of the man of Chapelle-aux-Saints, so now there is every reason to believe that the human attitude toward death will change in the future, just as it has changed in the past. One must remember that the Græco-Roman world in general regarded the problem of death with much less emotion than we. Nor can we overlook the fact that the two thousand years of the Christian era are but a very small thing in comparison with the fifty thousand years, more or less, which have elapsed since the days of the man of Chapelle-aux-Saints. Since we have been able to see what vast changes have occurred in the past, are we not justified in assuming that others will take place through the unlimited periods of the future?

I have said that Buddhism, one of the noblest and most

beautiful of religions and the one which to-day boasts the greatest number of followers, offers to the idealistic hordes of the Orient the annihilation of all life as the supreme reward. Shall we ever free ourselves from this obsession of fixity, which is wholly contrary to nature, and which, in an entirely selfish effort to immobilize mobility, makes us forget the manifold changes which have occurred in the world and in man?

Evolving man has so radically changed his opinion of death throughout the ages that I see no reason why I should accept the emotional interpretation offered me by the first parson I meet. The fundamentals of knowledge are about to undergo a complete and marvelous revolution. Sooner or later it is inevitable that, as a direct result of that change, our emotions will be so modified as to order themselves and develop in line with positive science.

In what circumstances and with what results will there come in course of time a modification, not of our conception of death, but of the emotion, the erethism of a congruous sensibility, the organic impulse of which must of necessity sooner or later die away. I do not care to guess, but I will express the opinion that some day our sensibility will become educated to a point where we shall no longer fear a life fuller of suffering than is our present earthly existence. Before our attitude toward death can change, our conception of life must change, and this must be brought about not only through an increase in positive knowledge, but through a fresh adaptation of our sensibility to it.

I have come to agree with Sainte-Beuve, who maintained that the man who really refuted Pascal's fear of the unknown was Buffon, who had begun the work which Lamarck and Darwin were to carry on. Indeed, from Buffon's day dates the beginning of the conflict between biological generalization and the emotionalism of that hereditary ignorance from which we have not yet wholly emancipated ourselves. Only one outcome is possible: our knowledge will increase and the qualms of fear from which our primitive sensibility has suffered will disappear in proportionate

degrees. That will be not only an evolution, but a revolution in man — slow, to be sure, but inevitable — which will transform our subjective conceptions of human life, of birth, and of death.

Of what importance, then, is the length of our existence if its very brevity is the condition of its subjective grandeur? Duration is a factor of secondary importance in the sum-total of final values. Whether calm or troubled, happy or unhappy, if life is a long struggle under preordained discipline, the anticipation of a long period of peace must be alluring, for it means the forgetting of disappointments, the healing of wounds, and the recognition of a task well done, even though it may have been an insignificant one. That is what the poet gently tried to hint when he wrote:

‘Leave life as one might leave the banquet-hall.’¹

To me, that seems the epitome of a wise philosophy. For each of us life is a banquet, the beauty of which for each guest is proportionate to his share of the cost if it be true that the highest happiness lies in giving as much of oneself as one possibly can. Are we going to complain that the entertainment ends too soon, because our powers of feeling become exhausted? Are we, like revelers of decadent Rome, to have recourse to all manner of devices to prolong the feast?

‘... I would not die so young ...’²

poetically exclaims the ‘Young Captive.’ Tell me, pray, since you ask for a continuation of life, upon what terms would you accept it if you had also to accept all the consequences? To exist in a state of continuous sorrow is neither life nor death. At most it is to pant in impotence when to be human we need to comprehend, to will, and to accomplish. The man who has not raised himself to the heights of complete self-denial is unworthy of the beauty of death wherein the rhythms of action and of repose, so closely interconnected, control each other.

¹ ‘Qu’on sortit de la vie ainsi que d’un banquet.’

² ‘... Je ne veux pas mourir encore ...’

Will men never realize, now that they are brought face to face with themselves and with the world before the tribunal of their own sensibilities, that this dread of death which haunts them unceasingly only proclaims their cowardice? 'What of the hereafter?' you ask. And I reply: What of the 'before'? What did you then, and what did you make of yourselves? Has that period left you unpleasant memories? Was not the problem the same at the beginning as at the end of that life which causes you to inveigh so bitterly and so vainly from birth to death?

Before you died what use did you make of that power of action which was given you, and which you are so unwilling to relinquish? You sought second-rate pleasures, including that of blaming the world in order not to blame yourselves, and in childish stupidity you awaited the apotheosis of a heavenly after-life, free of any productive activity. Whether life be eternal or not, of what use is it without a motive for living? Good, without complementary evil, becomes a hollow word. To make life eternal, its elemental conditions must be done away with, and what is individual must be immobilized and finally annihilated in order to free it from the action of time.

Can you tell me, after carefully pondering the question, what purpose your life has accomplished? I do not ask what you have said. I ask what you have done. Show me the means that were at your disposal and what you have done with them. Your gift of thought amazes you? Have you embodied your thought in action? A fine thing, indeed, this flapping of wings amid the cycles of infinity! You have chosen theatrical vanities and preposterous vaunting of deformations which you have named individual growth. But the very next step you take along the path of knowledge will show you the worthlessness of what you have done. There have been too many verbal disguises, too much voluntary shutting of the eyes, too much premeditated indifference, too many masks on too many faces, too much exaggerated praise of simple virtues. Why not, rather, seize the opportunity of being fully yourselves and

of looking life squarely in the face, in order to enjoy to the full the elemental harmony? Did Greece or Rome, to say nothing of Asia, require an eternal heaven or an everlasting hell to produce the finest examples of humanity in intense action? How can you claim credit for their history, when it will surely disavow you?

The supreme intensity of the forces of life forbids that their action should be diffused over a long period. The evanescence of joy, the bitterness of regret, and the smarting wounds of remorse sink pell-mell into the oblivion of a general amnesty. Were that the act of some almighty power, gladly would I render thanks to it.

I might drop the argument at this point, for the sole reason that the laws of the universe determine man, who is implicit therein, but I am anxious to consider the stand taken by those who contradict me, and to ask them whether the according of subject and object which constitutes knowledge cannot and should not end in the according of human emotionalism and the cosmic activities in which we are enveloped. It is the great problem of universal adjustment to which I am constantly returning. Harmony between knowledge and emotion must be established and perfected, instead of becoming lost among irreconcilable differences. Must we then give up the idea that until that general return of subjective activity into the infinite reservoir of the objective which we call death, we can unite in exercising the organic attributes of the man who can perceive, and think, and yearn for better things?

A dreamless sleep, that is, a purely negative state of unconsciousness, is all that we can anticipate of death. That is not very terrifying. An absence of pleasure; an absence of pain. To dread such a state surely indicates a lack of balanced judgment, since we enter it, by no means without satisfaction, at the end of every day. When we have completed our daily task, do we not seek to recuperate in sleep? Death is no more and no less than sleep. In the evenings, every one looks forward to the approaching hours of unconsciousness. Insomnia is considered an unsurpassed evil.

How senseless it is, then, to inveigh against a state the rhythmic return of which we value so highly!

WHERE IS THE STAR?

Last month, at his request, I was saying farewell to one of my dearest friends who was returning to the earth as simply as he had come upon it. It suggested to me the thought that 'Death is a purification of life.' The following day a journalist declared in his newspaper that such a remark from an atheist meant nothing. Can the dogmatists and their followers of all denominations maintain that we who are not of their way of thinking cannot consider death as an 'idealistic completion' of life? I fully recognize that their inadequate observation requires an indescribable heaven and hell by way of sanction. Is that any reason why people who have emancipated themselves from atavistic limitations should not be allowed to give up these memories of a mental childhood, and should be forbidden to build their 'life' in terms of an ideal activity of which death, as the final test, is the worthy crown? May we not believe that the vicissitudes of life will afford the compensating joys and sorrows needed to correct the shortcomings of destiny? Our emotions, result of an unstable mixture of high idealism and of the common cares of which we cannot always rid ourselves, are encumbered with too heavy a crust of secondary interests, of concessions to weakness, and of compromises with abuses to which we assent or in which we seek our own advantage. It is the slag of the ideal, and we wearily bear its weight upon our shoulders.

The best men, as they grow older, little by little break away from the hypocritical conventions, which appear important only to the supersensitive. When we are born into life we are also born into death. From the moment we come into the world, death is drawing near to us, and, as time goes on, the thought of the inevitable end tends to detach us from the shallow artifices of life. Then begins the departure of those thoughts and instances which in one form or another crowd the memories of every one. Who

at the approach of death does not glow with pride over some noble hours and burn with shame over some sorry days? What, after all, is retribution, if not unspeakable misery at the thought of having been unworthy of one's self and disloyal to others, of having striven so weakly for the ideal that one succumbed to temptation? Do these recollections of happiness and of sorrow, of strength and of weakness, count for nothing in the ultimate lesson of a life the last thread of which is about to break? The futile commotion which surrounded the agitations of life falls forever quiet. Of past shortcomings nothing remains but the surge of a belated repentance, all the more cruel because it is too late, whereas the finer side, 'purified by death,' remains for those who survive, and who need the lesson of example to supply them with a standard.

Is this survival of our ideals less fine than the proposed alternative, namely, the theatrical climaxes of heaven and hell? No. We may unhesitatingly speak of a 'purification of life by death,' provided that the life that is done leaves echoes that prove it worthy to be purified. Death collaborates in giving dignity to life. Neither the Greek nor the Jew, as I have already noted, required the bait of an after-life to attain to the highest pinnacles of human nobility. Socrates would have been much less great had he counted on a celestial reward, and, not to mention other men, Phocion with his own money paid the man who was to prepare the draught of hemlock, but who, being weary, proposed to postpone the execution until the following day.

Indeed, long, very long before the triumph of science, a lofty emotionalism had exalted the masters of idealism to heights of thought which dominated the entire plane of human life. They did not know, and in fact, could not know, the laboratory. In the first flight of an exquisite sensibility, they trumpeted forth man's need of a synthesis of the ideal, and this was long before they had any knowledge of science. Our enthusiasm for research is not exhausted by rebellious phenomena. The magic spell of positive knowledge calls forth the uttermost resources of our will-power.

Idealism is not the result of logical thinking. It grows from man's making the greatest effort of which he is capable. Since the directing principle of man cannot be the avoidance of suffering at any price, and if it is, in fact, a fine thing to accept suffering, yet scorn it, to seek it, yet despise it, as did the ancient martyrs in their generous ardor for noble achievement, then idealism can lift man to the highest pinnacle of his destiny, through supreme suffering in the service of an idea. The beauty of great causes, to which what is best in human life is attached, is revealed in the band of heroic men, known and unknown, who chose to sacrifice their lives without thought of reward for the keen joy of unselfishly doing their duty.

What then can we gain by refusing to admit scientific facts, in order to accept the hallucination of a future life beyond the confines of this world, charming only because of its unreality? Can we successfully substitute for the positive world the dream of an imaginary existence upon which to expend our energies? It is a great temptation to make promises which we have no intention of keeping. That is what is most obvious about the march to the imaginary star of eternal human felicity.

Evolution of knowledge must increase the instruments of our activity. Will it then make us happier, more powerful, longer-lived? To answer these questions with certainty would require nothing short of a precise definition of eternal happiness — than which nothing is less stable, less subject to definition, or more various for each and all of us. Experience proves that to our innermost sensibility, the fleeting happiness of each of us is in himself and in the satisfaction that lies in his power to adapt himself to his surroundings. Thus decrees the subjective character of the sensation of happiness, sometimes common and sometimes refined, to which we aspire, usually without being able to realize it except through anticipations that are found baseless as soon as they are formed. Knowledge supplies the means for momentary or durable happiness. These means we must utilize. Each person can be at least temporarily

happy within his own limitations, according to how high or how low is his conception of life, and according to how great is the personal will-power which acquired knowledge and strength of character have allowed him to devote to the task.

How many will be able to understand this fact, and amid the vicissitudes of human society, such as invasions, wars, epidemics, and every other form of catastrophe, how many will have the chance even partly to act on it? The pitiless struggle for existence in time of peace has on the whole caused as much misery and death as have pitched battles. The simple-minded ideologue suggests that a remedy will be found in new social conditions which will do away with these evils, and which will automatically bring peace to men. Just so their even more simple-minded predecessors thought to alleviate earthly woe by the promise of an indefinitely adjourned happiness in an unknown, but eternal paradise — an enchanting land of inaction which, since happiness is dependent on action, is a contradiction in terms. To see what effect it has had on matters earthly one need only examine human history.

The inevitable growth of knowledge, freed through the growth of character from being dominated by emotion, could then only facilitate our achievement of that happiness which we never cease to desire, but which seems only too often to vanish when we think we have grasped it. Our ancestors of 1789 were innocent enough to believe that a mild, indulgent code would bring about a state of perfect happiness. Apt pupils of the Church, those 'liberators,' trusting at first, like their masters, to the formulæ of universal love, soon came to enforce them on the scaffold. To suppress the adversary in order to suppress his opinions is the dogmatic idea. The first benefit brought us by relative knowledge is the doctrine of universal tolerance. It is unfortunate that our empiricism has not progressed beyond the point of doing more than recommending its practice.

Furthermore, our conception of happiness evolves. As soon as it attains a standard higher than the gratification

of those purely personal desires which we at first thought represented happiness, we discover that the pursuit of an elusive selfish gratification is not a sufficiently fine end to which to devote our lives. Our prayer to God has ever been that he shall not destroy our hope of a state better than that which we have in the world he created.

If science must eliminate an impotent 'Providence,' there still remain our own efforts with which to establish a brief period of contentment on earth beneficial to each and to all. In other words, the evolution of man should bring with it a change in the character and quality of the personal happiness to which he perpetually aspires by removing the fears which perpetually besiege him. The happiness which is to-day attainable by the most emotionally devout is still very primitive in its nature. Hope for a minimum of earthly suffering, and a belief in a maximum of felicity of an unknown sort in an unknown place at some future time, are proof to-day, just as they were in the past, of simple-mindedness. Animals avoid pain as eagerly as we, but they are incapable of generalizations that seek to control the future. Evolved man certainly is entitled to improve on the mental needs of the man of the quaternary age.

The quality of happiness will be purer, and in the general estimate of our life the importance of suffering will be lessened through the relief afforded by the rise of a stoicism capable of bringing out what is strongest in man. Is this not borne out by the fact that men who have undergone suffering and faced death for an idea seek their happiness in a realm higher than the one in which average men seek theirs, and appear to have found it? Socrates in his address to his judges did not bewail his fate. Condemned to die, he regarded death calmly. He said quite simply to the executioner: 'The time has come when we must part. You go on living and I die, and only God can say whose is the better lot.'¹ Does it not seem as if a veil were lifted, and that man, grown in stature, finds that he is the master of his destiny?

¹ Christ's cry of '*Eli, lama sabachthani*,' proved how human he was. He was greater emotionally than he was philosophically.

Long before Socrates, Buddha, followed by hundreds of millions of disciples, lived according to the best that was in him, and, after a well-filled life, expected nothing but an unending rest.

Nevertheless, most men live and die without ever grasping the fact that life prolonged into eternity, which is what they hope for, is a cosmic impossibility in flat contradiction with everything which science has established. In increasing old age we have a daily proof of an organic regression, of an evolution drawing to a close. The Church very prudently abstains from telling us of what age we shall be on our resurrection. To do so would involve too many unpleasant controversies. On the length of our lives depend the good and evil which we do. We are no more responsible therefor than we are for our birth, and yet it is precisely on that score that the Almighty is supposed to punish or reward us. For Providence knows only a stable and unchanging humanity such as primitive intelligence was able to conceive. Providence was wholly ignorant of biological evolution or of the rotation of the earth. Indeed, we have learned a great many things of which Providence knew nothing.

If our conception of the universe, including humanity, is the mainspring of our individual activity, the law of least resistance makes it inevitable that the chief guiding factor of our lives should be an aspiration toward an ideal which performs the function of a lighthouse, or of a star, by which we may get our bearings. Through mingled action and reaction our general formulæ of the universe, sprung from the deep consciousness of progressive sensations, starts us into action according to our individual measure. We are looking for something fixed, and it is not to be found in the universe. Although the pole may shift, the needle of the compass continues to supply us with valuable information as to our relative position, since we are both being swept along in the universal movement. In our own case, the outbursts of organic impulsions for a moment let us see beyond ourselves as if we were star-shells seeking out the lines of the road. That is what we term 'the ideal,' that is, a

vista of imagination, the accuracy of which, after due allowance for error, may perhaps permit us to glimpse, and even to examine, parts of the horizon.

If action were equal to reaction, there would be no such thing as evolution, and the universe would forever remain a pendulum lacking the impulsion to set it in motion. It is the difference between action and reaction which produces evolution. And, although we are unconscious of the movements of vegetative life, it is the sense of there being a margin beyond ourselves which makes the imagination, happy to anticipate in a vision the hopes of the morn, to leap ahead of those gleams of light in which while the darkness still remains, we seek the first signs of the approaching dawn. It may be only the play of imagination, but its effect is none the less strong, since, in spite of errors which will later be corrected, it lights the road. Have I not already called attention to the fact that imagination *creates* nothing? It merely enlarges known facts and sometimes distorts them. What does it matter whether the star toward which we travel is the flicker of a near-by candle, or the vast incandescence of an infinitely distant astral body? It will have, for a moment, lighted the road of an ephemeral life, and we shall have advanced.

The first act of idealism in the earliest days of thought was to personify the activity of things. This was most natural at a time when man could not have had even the most rudimentary idea either of analysis or of synthesis. Furthermore, how much more tempting to begin with synthesis? The great problem of to-day is to determine whether we shall regard our acquired knowledge as decisive, or whether we shall cling to the results of a hasty primitive enquiry in order to reconcile ourselves to the incongruities of an outworn 'ideal.' The first thing to do is to depersonalize the unknown. A purely intellectual mind not only would not reject, but would welcome, the procedure, had we not taken as life-companions sundry divinities who assure us the infinite pleasure of confiding, friendly talk. Such intercourse, since it occurs between Almighty Power and total weakness, should, it seems, be clear gain for us.

Are there, however, greater joys available to us? I have tried to point out that there are. Since the Divinity is merely a representation of the 'ideal,' we need only comprehend that the 'ideal' with all the charm of its imaginary splendor ceases to be the 'ideal' the moment that it takes material form. The purely human impulses of the various gods throughout all history prove the point conclusively. Thus, an 'ideal' which produces anything so illogical as heaven or hell is, *ipso facto*, a failure. The vision is beautiful only so long as it remains a vision. That is why the 'depersonalized ideal' of Buddha had, and still has, such a tremendous power over peoples of the finest emotional nature.

I do not dispute the fact that in the beginning divinities helped man to guide and regulate his life. That they have frequently led him astray, as in the pertinent case of Galileo or of all the exploits of the Inquisition, the concerted silence in respect to them is a clear enough admission. No matter what happens, if one of the faithful once finds himself in possession of what he regards as a powerful talisman, it is hard to separate him from it. On the other hand, how are we to identify the one and only God in an assembly of gods, mutually exclusive? And how can this rubbish-pile of errors be considered as containing any evidence of truth?

Doubtless people will say: 'So your ideal is nothing but an unrealizable dream, which leads us astray and lures us into deadly pitfalls! Yet in our eyes divine love is ever-present and ever solicitous over our inevitable shortcomings. You try to guide your steps by the light of a spark; our guide is a blazing star. Dream on, if you will, of your laboriously systematized empiricism. We prefer to live by the absolute, which it is our task to realize in ourselves.'

My answer is: I quite understand that you say so, that you think so, and that you wish it to be so. But is that enough? The absolute, by definition, cannot be personified, that is, circumscribed or limited. We have spent centuries to reach a state where we could debate the point. With your luggage or with mine, we both allow ourselves to be swept along by

a life for which we did not ask. Seeking for guidance, Pascal came very close to the point of admitting that the chances of being right or wrong were about even. Can any one deny that since Pascal's time our knowledge of the world and of ourselves, has increased? The truth of the matter is that our fathers were afraid of death, just as children are afraid of the dark. Well, the problem of darkness is solved by a light. All I ask of you is that you adapt your outworn emotionalism to our modern basis of observation.

You ask us to live superior to reality, and you turn away from my ideal, which seemed to call you to action. By my own effort I can at least attain to certain parts of my ideal, since it issues from me, and, therefore, conforms in its broad aspects to the general dimensions of my activities. It will overlap its frame. Of that I am quite aware. What do those parts which cannot be realized matter, if, under the influence of that ideal, the scope of our human effort be enlarged? Will it be held up against us that the finest acts of heroism, performed in the supreme joy of self-sacrifice, were done in the name of ideas which were never realized? Is Demosthenes to lose some of his greatness because Greece, the standard-bearer of civilization, did not remain worthy of her destiny to the very end? Demosthenes died for an idea born of the best that was in him, and when the soldiers of Antipater tore him away from the god who had withdrawn his protection from him, his was the ineffable joy of a moment of a higher life which many a pseudo-great man has been too small to envy him!

By the light of an ideal which shines above him, any man, worthy of the name, marches like the heroes of legend toward the realization of a dream into which he has put complete abnegation of self. Why do you who praise him begin by saying that you are incapable of a self-denial which is not to be rewarded? Cannot you understand that the ideal is and always will be its own reward? The hero that at certain hours of our lives we all of us are would not lower himself to accept reward. In his relativity, he gladly bears

the blows dealt him by the wings of an imagination no longer weighed down by the burden of interested motives.

The 'ideal' without which life would consist of nothing but deceptive confusion, is like the bearings we take from the pole when sailing unknown seas. Necessarily, in our early conceptions of the world, our ideal was commensurate with our powers. By developing our knowledge, the scope of which is constantly increasing as we add new verifications, we have been able to transform that primitive ideal. The relation between evolving hypotheses and the corresponding evolution of science has put the life of man on a level far beyond comparison.

If the ordinary man ever succeeds in raising himself — and he can raise himself only at the cost of great effort — if, I say, he can raise himself above the childish lure of reward balanced against punishment, his idealism may lift him, as happened not infrequently among our great ancestors, to a serene and even happy acceptance of full self-sacrifice for an idea, even though the sacrifice is made harder by the hatred and curses of those who do not understand. Will the Christian martyrs and the arch-heretics who succumbed under the blows of the 'orthodoxy' of the Councils, be finer, or less fine, examples of humanity, according to the sum total of ultimate criticism or commendation which the future awards them? As I have already said, it is less the degree of positive realization which determines heroism than it is the outpouring of an emotion superior to that of the general run of mankind.

When the thinker has finally become reconciled to a continuous observation which at once puts him into contact with the indifferent but irresistible Cosmos, he must, as far as he personally is concerned, trust to the pride of possessing a courage superior to all weakness whether avowed or disguised. This will not be the lot of most men. A mountain towers above the valley, and if one proposes to ascend to the peak, one must have the inclination to climb. Is that the same as saying that if some set a magnificent example, they will not fire the imagination of the crowd?

By no means. Only the masses need success to encourage them, whereas the lone proponent of an idea will draw upon his inner exaltation for the final effort.

It is not momentary success, instinctively worshiped by the masses, which makes a man any more than it is those childish distinctions and honors which men so highly prize. It is rather a lofty emotionalism, carried to that point of exaggeration which makes possible bursts of apparently impossible energy. For that reason, the most scientific of scientists will ordinarily be admired on trust, whereas the powerful sentimental quality of a Buddha, a Christ, or a Mahomet will stir masses of people to splendid and disinterested activities, because they see the chance to express their idealism.

The power of idealism is what, under whatever form or name, more than anything else fascinates us, holds us, and moves us to the very end of our lives, without our trying overmuch to draw the line between fiction and reality. Reducing the ideal to a concrete form called Divinity was the act of primitive man and opened the way to every sort of misunderstanding. To analyze that ideal with the aid of theology and metaphysics became the task of reasoning ages. At last we are drawing near the day when the God who so long has been the absolute master of prostrate man, will crumble before the cross-examination of erect man, and will leave behind only the ephemeral remains of a name without substance.

The hour of knowledge of the omnipotent Cosmos has struck. It is man's day, for the eternal 'nature of things' will be brought directly to account by an intelligent posterity capable of looking without fear on the infinite. It is the day of the supreme magnificence of the scientific wonder-tale from the atom to the endless path of flaming stars, the fires of which will be perfected in the activities of living and thinking organisms. And these organisms will dare question the universe and, marvel of marvels, will obtain answers. How can one compare the paltry miracles of Holy Scripture with such dazzling things as these?

Once freed from the obsession of a divine power, man arrogates to himself the right to formulate a subjective opinion of the Cosmos of which he is a part. He finds himself infinitesimally small, yet none the less capable of a reaction of individual thought in conformity with the law of cosmic energy which he has the good fortune to know and to gauge. Does not his very littleness become the best proof of the imposing relation between the infinite universe which is unconscious of itself and the organic particle which feels itself to be alive, that is, for a time to be capable of opposition?

The whole history of man over which we make such a to-do, resolves itself into the question whether he will prove himself emotionally capable of facing the lot which science seems to have decreed for him. We are the ephemeral masters of the elements in which the final mastery remains, and it is our unasked-for fate to be born and to die in a sequence of phenomena wherein our part lasts but a brief instant. Gleams of knowledge and mists of dreams make the beauty and the mystery of those celestial spaces that turn by turn invite and rebuff us. That, in the vulgarity of our sudden rise in the world, we demand more, is immaterial, since the law of the Cosmos must always prevail.

To study ourselves in our actual dimensions in order to develop in line with an 'ideal' which is in accord with cosmic destiny, but which cannot point the way unless it keeps in advance of us, is enough to establish the guiding point of a luminous wake from which we can infer toward what star we have marched. Is not that exactly what the astronomer did when calculating the position of a hypothetical star, the existence of which had been indicated by the actions and reactions of the system as a whole? We no longer seek our destiny in the stars. We have learned to look for it in our state of knowledge, in our preferences, in our wishes, in our good and evil deeds, and in the inevitable consequences thereof.

In comparison with the verbalism of the ideal of which we talk so glibly, our actions may seem paltry. Yet many of

them would cut a pretty fine figure if, without undue modesty, we gauged them by our inherent weaknesses. For many centuries religion has demanded that we perfect ourselves through a severe and noble effort of self-denial. The only result has been indifference on our part, or the ritual gesture of *do ut des*. From our elementary comprehension of things, can we expect anything better? It is not impossible, provided we are capable of appreciating how truly great we are, and that the cornerstone of that greatness rests on our knowledge of the world and of ourselves.

Too long misled by the mirages of the Cosmos, we have vainly sought beyond the clouds an 'ideal' power mystically personified, to which was to fall the task of perfecting us through the effect of divine grace, and which was to make no demand on our personal efforts. Are we unable on our own initiative to complete our lives? Must we look to the skies for that completion? We must show ourselves worthy of our destiny before the eyes of the world, without expecting any help from the absolute, which is ignorant of our existence, since it cannot descend to our level. We must give up the idea of forcing our will and our ideas upon one another. We must prove ourselves strong men, but we must take no greater pride therein than that which comes of knowing how weak we are, and that, in spite of it, we have grown, have willed, have achieved.

The day is coming, arduous but inevitable, on which by the simple evolution of knowledge will occur that most beautiful and complete phase of human development which will entitle us to take part in the work that the Cosmos requires. We need only renounce the heavenly mirages of a divinely personified energy in order to put man, at once fragile and strong, into full possession of that actual power or knowledge which alone can perfect him.

'Master,' the disciple cries, 'who is that God, robed in dazzling majesty, whom I discern yonder above the clouds? Methinks he seems to call me. Didst thou not see?'

And, smiling, Buddha replies:

'It is thyself whom thou seest, O my son!'

Is it not the same story as that of the child who seeks the face behind the mirror? The child will learn. Why should not man who is seeking to find himself, and who is succeeding in so doing, complete in full flight the noble conquest of himself by emotionally accepting his destiny?

In that state of mind, freed from the world, freed from myself, let my last presumptuous deed be to set down here the independent speech of one who goes his way in the 'evening of his thought.'



THE END

